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Noise Pollution

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ENVIRONMENT VIEWS

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Alberta
ENVIRONMENT

Introduction: Gillian Sniatynski

The Insidious Pollutant

The real costs of clean-up are still being reckoned.

In pre-industrial times, says a background paper on noise prepared by the Environment Council of Alberta, the loudest sounds men were likely to hear for any length of time were their own voices. The loudest periodic noise was thunder.

Industrialization and its associated technology, population growth and the growth of big cities have dramatically increased the amount of noise to which people are exposed. And sources of noise are increasing all the time.

According to a report by the U.S. Environmental Protection Agency administrator, quoted by Edgar Shaw of the National Research Council, the number of cars in the U.S. increased from 40 million in 1950 to 87 million in 1970. The number of trucks increased from nine million to 18 million in the same period. There were 200 commercial turbo-fan planes in 1960, and 2,000 in 1970. The administrator's report, says Shaw, also records a "tremendous proliferation" of gasoline-powered tools and recreation vehicles. For example, gasoline-powered lawnmowers, which were rare in 1950, numbered 10 million in the U.S. by 1960 and 17 million by 1970, while snowmobiles, which were non-existent in 1960, numbered nearly one million in 1970.

Lauren Dale

All this, while industrialization proceeds apace, and sonic booms and space shuttle launches make the skies split with sound.

To live without sound would be to live in the isolated, even dangerous world of the profoundly deaf. We need sound to communicate with words and music, to get extra information about what is going on in the natural world, to keep tabs on what we can't see.

But can there be too much noise? Emphatically yes. Elsewhere in this magazine the effects of noise as a health hazard are detailed. Briefly, these effects can be auditory, as in noise-induced hearing loss, or extra-auditory, involving physiological and psychological reactions to noise as a source of stress.

In a background paper prepared for the Environment Council of Alberta, psychologist Dr. Bruce Dunn of the University of Calgary elaborates:

"Hearing loss is an acknowledged and accepted medical problem which has serious social implications . . . Even without hearing loss, however, noise can interfere with the ability to understand speech and has been considered an abridgement of human rights. Such intrusions interfere not only with speech as an abstract thing, but with the performance of tasks requiring speech communication and the processing of all sorts of task-related auditory signals. Noise affects the performance of a variety of tasks in ways quite apart from the inability to process auditory information. At what levels and how important are these effects? Stress that eventually leads to emotional and physiological problems may be one of the effects. If this is true, the problem again is within the high priority realm of medical consequences. Many people feel that their performance is hampered by lack of sleep quite as much as by noise. How sensitive to noise are people? What are the effects of interference with sleep? Again, the answers may imply medical consequences."

If their effects are as serious as Dunn suggests, why are noise levels allowed to keep growing? Why, in the apparent absence of effective formal controls, do the citizens not rise up in protest?

Partly, perhaps, because not all citizens are similarly affected by noise. Individual sensitivities differ, as do individual judgments about pleasant and unpleasant, wanted and unwanted sound.

Then, too, there is a lack of awareness, even among those worst afflicted, of what the harmful effects are. Hearing loss often isn't noticed until irreversible damage is done; irritability and high blood pressure may be attributed to life stresses other than 24-hour traffic noise from the freeway next door. This is perhaps not too surprising when even the experts admit to gaps in their knowledge of noise as a health hazard.

Noise pollutes the environment just as pesticides and noxious emissions do. And as with every environmental problem, the issue often comes down to a trade-off. We may, for example, complain bitterly about

The physics of sound . . .

The source of noise is vibration.

When someone speaks or claps or drops something, the vibration set up compresses the surrounding air. Air pressure is momentarily raised, then as the air rebounds against the vibration there is a period of relatively lower pressure.

These alternating periods of high and low pressure make up a sound wave. The amount of pressure or energy in the wave depends on the force of the original vibration, just as a rock thrown into a pond sets up bigger waves than a pebble.

When they break on our eardrums, sound waves set up mechanical vibrations which are passed along as nerve impulses to our brains. (There is more detailed information about this process on Page 16).

Loud sound is perceived as different from soft sound primarily because of the size of the pressure changes. This pressure or energy is also referred to as *intensity*, which we usually perceive as loudness.

(There are some variations to this general rule, though. Sounds of short duration don't sound as loud as sounds of the same intensity but lasting longer. And our ears appear to adapt to steady sound, which after a while sounds less loud.)

Sound is measured by the pressure it exerts — and the human ear is capable of responding to a vast range of pressure changes. The difference between the acoustical pressure which is barely audible to a young, normal ear and the pressure which constitutes loudness to the point of discomfort represents a range corresponding to a ratio of 1 to 1,000,000.

Because of this extreme range, and to make measurement and calculation easier, sound level measurements have been compressed in a logarithmic, rather than a linear, scale, whose units are called decibels (abbreviated dB).

The decibel scale has a fixed and internationally accepted reference point, namely the sound pressure for barely audible sound in a controlled laboratory setting. The use of the decibel scale to describe sound pressure is thus similar to the use of the thermometer to describe how warm something is in comparison to the thermal reference level, melting ice.

Our eardrums are also very sensitive to the frequency with which sound waves hit them, as well as the pressure they exert. The rate at which the waves are repeated is called the number of cycles per second, termed hertz (Hz).

One sound or tone consists of waves being repeated at a fixed rate — one frequency. A tuning fork, for example, emits a single-frequency sound of 128 cycles per second (Hz).

"Sound we hear every day is a complex combination of many frequencies," notes a background paper produced for the Environment Council of Alberta.

"Another term, pitch, refers to the way in which we hear these various frequencies. Sounds of many low frequencies are heard as low pitch and sounds of high frequencies are heard as high pitch."

The frequency range of the normal ear is 20 to 20,000 Hz — but there is not equal sensitivity across the entire range. Human hearing is most sensitive to frequencies from 500 to 3,000 Hz, the most important for understanding speech.

Our ears discriminate strongly against sound at lower frequencies — a fact which accounts for another convention in sound measurement. Sound pressure exerted on the diaphragm of a sound level meter is converted to an electrical signal which activates an output meter giving the reading. Meters, unlike ears, would respond to all frequencies in the same way, so particular circuits favoring particular frequencies are weighted. Weighting networks are labelled A,B,C and D, each representing a different frequency bias. The A network discriminates strongly against low frequencies, as the human ear does, and it's been found to be the best reflection of an individual's subjective impression of sound. For that reason, the A network is most often used for sound measurement, and readings are recorded as dBA.

The hearing experience, as the ECA paper summarizes, "depends on the pressure and frequency of sound waves hitting the eardrum."

But the sound wave that actually breaks on the eardrum has been greatly modified by its journey through the atmosphere from the sound source.

In the absence of turbulence and temperature gradients sound simply spreads out, travelling through the atmosphere at a rate of about 300 metres a second, and becoming progressively less intense with distance from the source. (In fact, as

Lauren Dale

noise along designated truck routes — but trucks are an important link in the commercial chain which ends at the neighborhood shopping centre.

In a brief to the recent hearings on noise

the distance doubles, the sound decreases by 6 dB. So if the sound level 200 metres from the source is 80 dB, at 400 metres it will be 74 dB, at 800 metres it will be 68 dB, and so on).

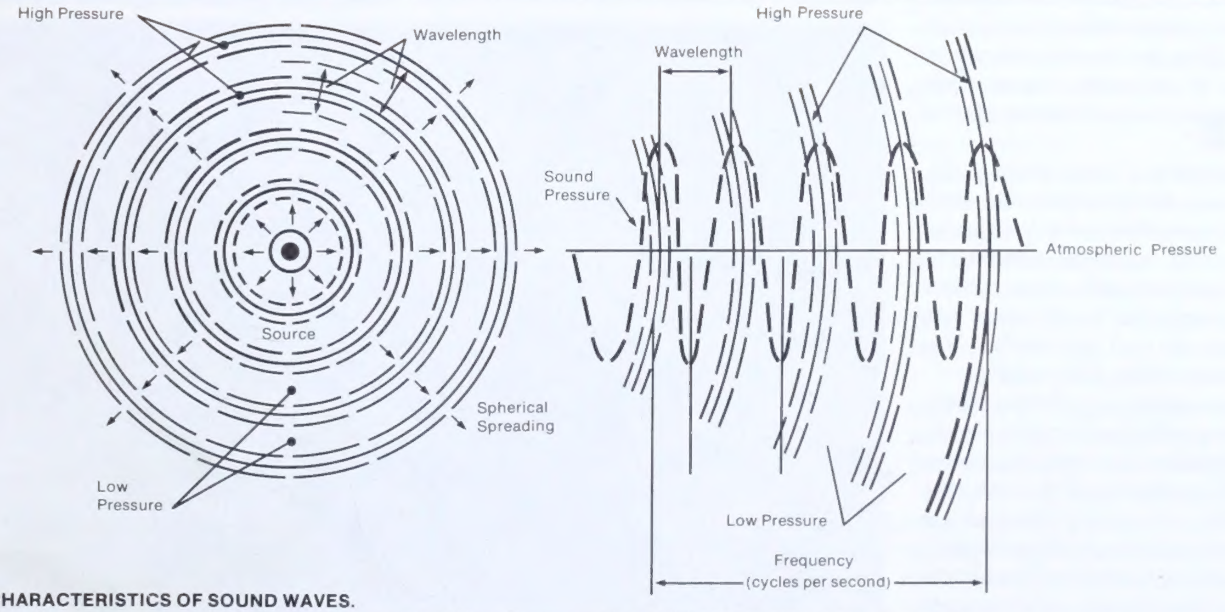
"The propagation of sound outdoors can be a fairly complex process," writes Hugh Jones, now at Dalhousie University in Nova Scotia, formerly chairman of the ECA's ad hoc committee on noise. "Often the sound we hear has travelled through air which has noticeable temperature variations and turbulence. Under these conditions, sound travels in convoluted paths. Often, sound we hear has travelled over ground, which causes a very rapid attenuation of its intensity" — especially if the surface is spongy and grass-covered.

Railway noise, for example, is more noticeable in the early morning because of temperature inversion conditions. If the temperature of the atmosphere progressively decreases with altitude, as is the case on a normal sunny day, sound waves are bent away from the earth's surface; during temperature inversions they tend to be bent back towards the ground.

Turbulence scatters and deflects sound. Topographical feature can also be important — sound may reflect from hillsides and produce higher intensities than expected at some points.

Obstacles and barriers like walls and floors also affect the path of the sound. Jones notes that a brick wall subject to a "reasonably high-frequency" sound will reduce the intensity by about 50 dB. But "if a hole is made in the wall, sound will pass through this without loss. Even a tiny hole will allow more sound to pass through than all the rest of the brick wall. This factor is sometimes overlooked."

As with musical instruments, there are three types of sound sources, says Jones: those which are scraped, banged or blown. Loudness of the source however doesn't just depend on the amount of energy available for conversion to sound. Jones considers the more important factor often to be the "coupling" of the source to the atmosphere. For instance, the tuning fork has to be placed on a surface which can vibrate and transmit its vibrations to the air before very much sound is emitted.



CHARACTERISTICS OF SOUND WAVES.
Sound waves consist of alternating periods of high and low air pressure that radiate out from the source to our ears.

From *Noise in Alberta*, Environment Council of Alberta

Sound Levels Around Us

Common Sources	Decibel Level or Range	Typical Reaction
	0	Threshold of hearing
Very soft sound	10	Barely audible
Radio station broadcasting studio	20	
Rustling of leaves	20	
Country home	30	Very quiet
Soft whisper at 5 feet	30	
Public library	40	Quiet
Quiet office or living room	40	
Moderate rainfall	50	Speech interference
Inside average urban home	50	
Quiet street	50	
Washing machine	47 to 73	
Light car traffic at 50 feet	55	
Normal conversation at 3 feet	60	Intrusive
Noisy office	60	
Noisy restaurant	70	— Possible hearing damage with continuous exposure — Telephone use difficult — Steady sound becomes annoying
Loud singing at 3 fet	75	
Coffee mill	75 to 79	
Tractor at 50 feet	78 to 95	
Busy traffic intersection	80	
Electric typewriter	80	
Electric lawn edger	81	
	85	Hearing damage (8 hrs.)
Bus or heavy truck at 50 feet	88 to 94	Very annoying
Jackhammer	88 to 98	
Loud shout	90	
Freight train at 50 feet	95	
Modified motorcycle	95	
Jet taking off at 2000 feet	100	
Amplified rock music	110	Maximum vocal effort
Jet taking off at 200 feet	120	Threshold of pain
Air-raid siren	130	

From *Noise In Alberta*, Environment Council of Alberta, Dec., 1980

pollution in Alberta, J.S. Lackie, assistant chief engineer to the truck manufacturer Canadian Kenworth Company, said: "I would like us all to remember this slogan: 'If you've got it, a truck probably brought it.' Most goods and commodities we use in our everyday lives, from the food on our tables to the gasoline in our cars, was at some point in the journey to commercial outlets carried on trucks."

This argument can be applied to many other noise sources: the manufacturing plant making something we demand to buy; heavy equipment carrying out road widening to accommodate increased traffic volumes. And what, after all, constitutes "traffic noise" but your car and my car and the vehicles of a few thousand or so other Albertans?

As with other sources of pollution, clean-up costs for noise pollution are only slowly coming to be recognized as real and necessary. Up to now, people haven't complained enough, perhaps — or haven't been aware of their own contribution to the problem. More importantly, noise-makers haven't had much incentive to make less noise because they haven't been polluting their own backyards; they've been polluting the vast communal backyard that is the environment, and suffering few, if any, consequences.

Another background paper produced for the Environment Council of Alberta, explains:

"Undesired noise, as a member of a large (and growing) family of environmental pollutants, is intimately connected with the concept of common property. In fact, all forms of pollution of concern to industrial societies are related to common property, the use of which is either unrestricted or the restrictions on which can be enforced only poorly, if at all. In this case the common property is the capacity of the environment to absorb sound. This capacity has been treated as virtually unrestricted common property, that is, property nominally owned by government but which can be used by anyone without charge or permission. Enforcement of noise bylaws is sporadic because of poor definitions of unacceptable noise in the by-laws, because of difficulties in measuring noise, and because of costs of enforcement.

"The economic impact of having this environmental capacity virtually freely available is easy to predict: the capacity will be over-used and will tend to be substituted for noise control measures because the latter have positive costs while the cost of the former to the noise maker is zero or near zero. This phenomenon can be observed

Lauren Dale

At the ECA hearings on noise pollution: information display (right); panel members (below).

Rolf Albert

wherever unrestricted common property occurs. Thus, fisheries tend to be depleted, common pastures tend to be over-exploited, and the environment becomes polluted with waste, including noise."

We are all jointly affected by what happens to our common property, and are jointly responsible for its care. Noise pollution clearly concerns us all.

The fact that many Albertans are taking these concerns seriously was apparent at the hearings on noise pollution conducted by the Environment Council of Alberta in centres across the province during June and early July.

The ECA panel conducting the hearings listened to information from transportation and medical experts, civic representatives; groups representing manufacturers and retailers of things like snowmobiles, trucks and motor bikes; and many, many citizens and citizens' groups.

The panel heard about the Edmonton neighborhood of Calder, which is under the two main approaches to the Edmonton municipal airport and adjacent to the speedway, as well as having two railway rights-of-way and their associated yards, and five 24-hour truck routes passing through.

Also in Edmonton, it heard from two industrial electricians, both of whom suffer from noise-induced hearing loss as a result of their work, one of whom complained: "They (the officials) are piddling round with 70 dBA and below. I *live* in 90 dBA."

It heard from a group of farmers in Lethbridge concerned about an asphalt plant located on prime agricultural land near their homes.

It heard from a group of Leduc residents who live adjacent to the roar of Highway Two linking Edmonton and Calgary, and who must bear increasingly high noise levels 24 hours a day.

Briefs were more extensive, and predictably more abundant, in the larger centres than in the smaller ones.

But ECA officials were pleased by the response, and by the tone of most submissions.

"We had anticipated a lot more of the complaining types," said panel chairman Roy McBride. Instead, panel members were "extremely favorably impressed" by the co-operative and constructive chord most participants struck.

Material collected during the hearings must now be pooled with extra information gathered by the panel and other ECA officials from experts in Alberta and elsewhere. The panel expects to produce its report to government, outlining the extent of Alberta's noise problem and strategies for its solution, in late fall.

One resource already tapped is the noise section of the U.S. Environmental Protection Agency, whose help, says McBride, will be "almost invaluable."

"The most successful part of their program in the States has been education and research," he says.

"The least productive was the regulation end." The U.S. agency found it more helpful to stop talking about noise control and work instead on "quiet community" programs.

In Alberta, too, education for increased awareness may be more effective than unenforceable regulations in helping us recognize the cost of noise, the part we play in the problem, and what we need to do about it.

Gillian Sniatynski is the freelance editor of this magazine.

VIEWPOINT

Sarah Burns

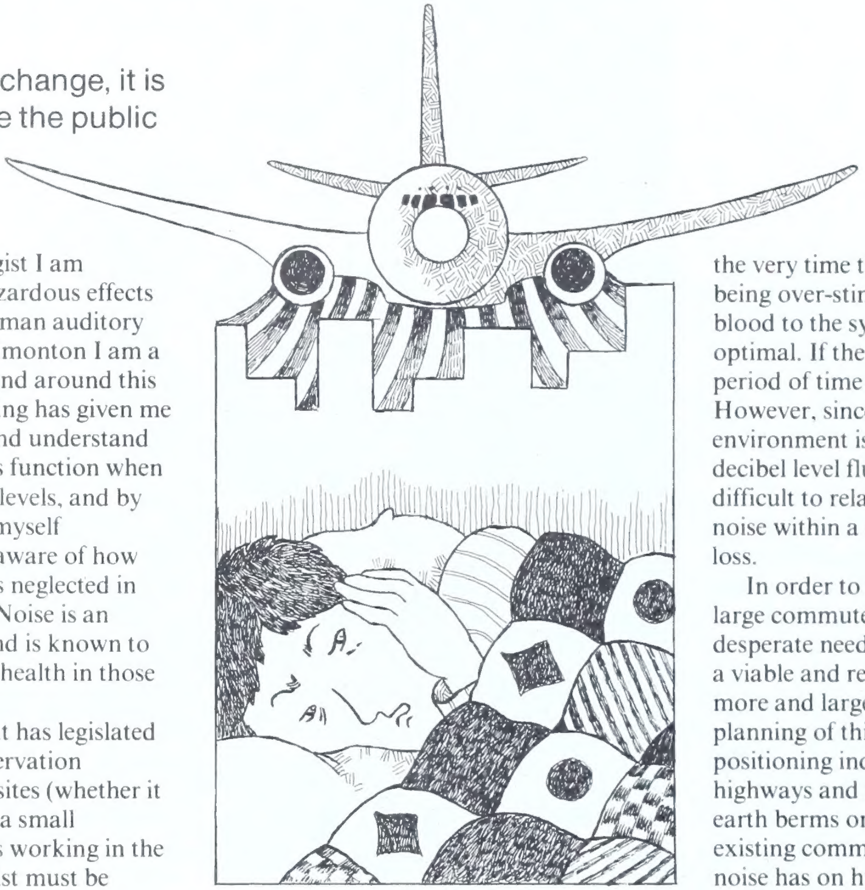
'In order to facilitate change, it is necessary to educate the public regarding hearing health.'

As a clinical audiologist I am interested in the hazardous effects noise has on the human auditory system. As a resident of Edmonton I am a victim of the noise within and around this city. My professional training has given me the opportunity to know and understand what happens to the body's function when exposed to excessive noise levels, and by living in Edmonton I find myself increasingly and painfully aware of how the pedestrian or resident is neglected in respect to noise pollution. Noise is an environmental pollutant and is known to have cumulative effects on health in those people exposed.

The Alberta government has legislated and enforced hearing conservation measures for employment sites (whether it is construction, factory, or a small duplicating room). Persons working in the areas where loud noises exist must be provided with ear protection and have periodic hearing tests to ensure no permanent hearing loss has been incurred. For the most part these regulations are adhered to and I suspect in the future I will be seeing fewer persons with significant hearing loss due to work-related noise.

What the hearing conservation legislation does not cover are those situations where industrial, airport or traffic noises are inflicted upon the public. The effects of this noise insult may include hearing and non-hearing symptoms. These symptoms appear to be universal, and can be seen in the person operating the construction equipment or the sidewalk supervisor.

Traffic and construction noise are known noise problems within the cities of Alberta. However for a number of different reasons I find it very difficult as a resident of Edmonton to attend only to that noise created by land vehicles when up to 32 times a day a 737 Boeing jet is allowed to land or take off within the city limits. The level of noise created by the jet, although intermittent, far exceeds traffic noise.



The construction of the human ear is such that it is a passive sensory system. When unprotected, as most pedestrians and home owners are, it will receive all sounds entering. A normal hearing ear will transmit the sound to certain brain centres for interpretation and awareness.

"Noise" has been described as any unwanted sound; whether the noise is judged as an annoyance or acceptable has been related to a number of different factors by several researchers. Most often cited as reasons for the annoyance or the acceptability response were the characteristics of noise, adverse meaning associated with the noise and most importantly whether the noise interfered with an ongoing activity.

When an intermittent noise, (in excess of 100 dB) judged as an annoyance reaches the unprotected ear, the result is a stress reaction. This chain of events is quite complex and has been dealt with in great detail in the literature. The stress reaction results in the constriction of the blood vessels temporarily, subsequently reducing the blood and oxygen flow to the brain and sensory systems, including the ear. So at the very time the hearing mechanism is being over-stimulated, the delivery of blood to the system becomes less than optimal. If the noise were constant over a period of time hearing loss could result. However, since noise in a non-work environment is usually transient and the decibel level fluctuates considerably, it is difficult to relate excessive environmental noise within a city to the onset of hearing loss.

In order to reduce noise associated with large commuter traffic volume there is a desperate need to recognize mass transit as a viable and responsible alternative to more and larger roadways. Careful planning of this expanding city by positioning industry between the major highways and residences, construction of earth berms or sound-reducing walling for existing communities will reduce the effects noise has on humans. However the Edmonton municipal airport is one of the worst offenders in noise pollution in Alberta. Yet the population of Edmonton continues to suffer so that 3,500 persons a day can get somewhere faster. There are five hospitals, a number of extended care facilities, and numerous schools in the N25 zone, but we continue to have large-body jets land within a highly populated city.

I believe that by examining the physiological effects of noise and the complaints the residents within Alberta have, the province can develop realistic regulations with no exceptions to the rules regarding noise levels, a virtually ignored public pollutant.

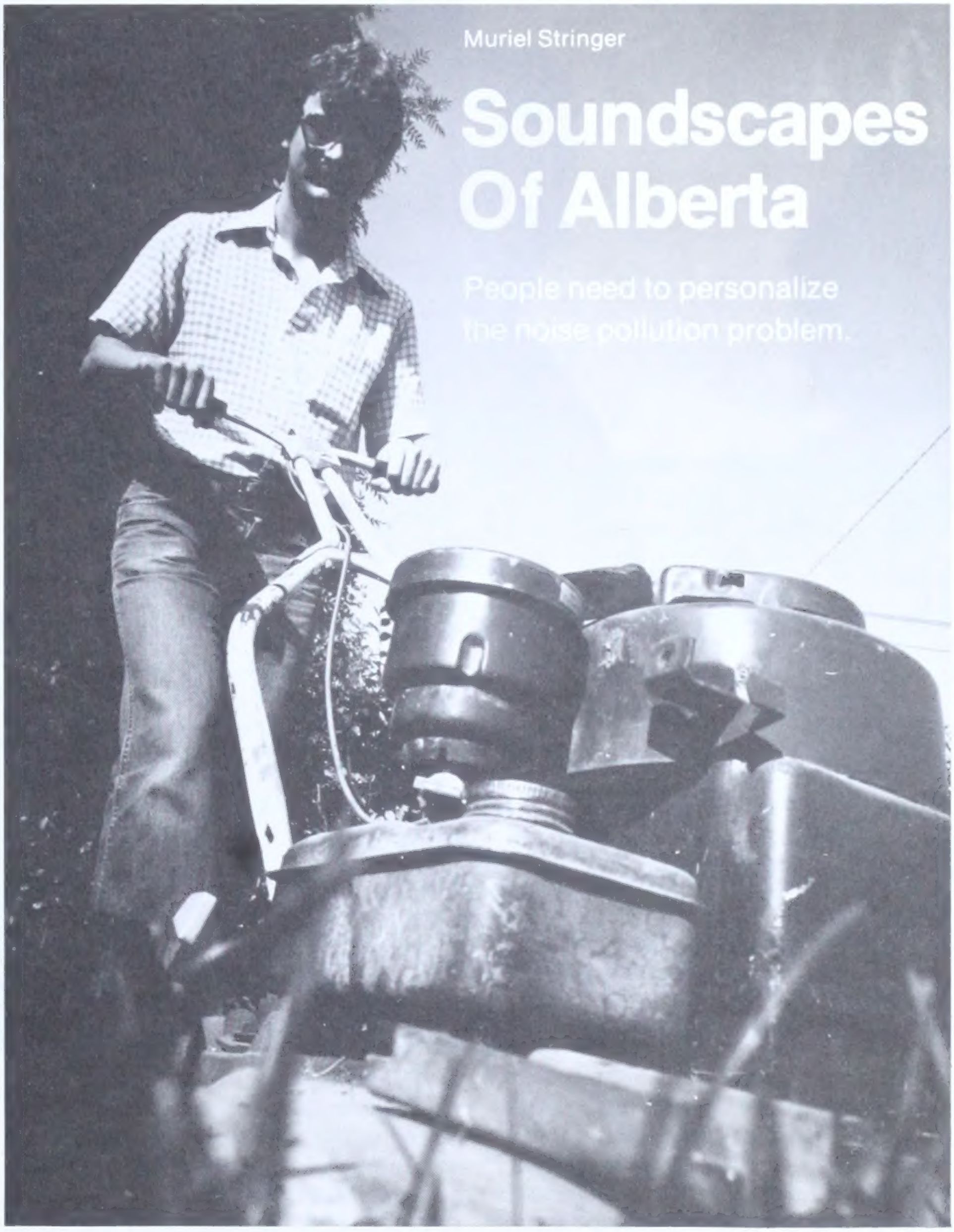
In order to facilitate change, it is necessary to educate the public regarding hearing health, and an important first step would be to make clinical audiologists more accessible to Albertans by increasing the service to include school systems and rural areas.

Sarah Burns has a Master of Science degree from the University of Wisconsin, Stevens Point. She is a clinical audiologist currently employed at the Glenrose provincial school hospital, Edmonton. This *Viewpoint* article was part of a presentation to the recent ECA hearings on noise pollution.

Muriel Stringer

Soundscapes Of Alberta

People need to personalize the noise pollution problem.



Tim Belec

Finding a variety of sound patterns or soundscapes in Alberta isn't a problem — it's figuring out how to escape from sound that's becoming harder and harder these days.

With the economic growth of the province and the opening up of many hitherto undisturbed parts of the countryside, noise levels are not only increasing throughout Alberta but are becoming more and more of a disruption in areas where most of us would expect a fair degree of peace and quiet. The rural idyll of the buzzing of the bees and the birds twittering in the trees is turning into a myth, and the search for silence is taking on the dimensions of the quest for the holy grail.

Tom Cottrell, a research officer with the Environment Council of Alberta, believes that farming operations themselves contribute a great deal to the surprising amount of sound invading rural tranquillity nowadays.

"The days of the plod of hooves and the creak of harness are long gone. Everything's mechanized now, and farm machinery makes a lot of noise."

The tractor, far from being a pleasant drone in the distance, actually puts out sound of around 90 to 95 decibels, depending on the effectiveness of its muffler.

"Some of the larger models have insulated cabs which may help the fellows who have to drive them but many farmers are still using older types which are pretty noisy. In fact, you'd be surprised how many farmers once they're getting on in years have hearing problems. Sometimes, too, the cabs tend to magnify the sound. And they certainly don't help all the people in adjacent acreages or anywhere within hearing distance of the din."

But tractors aren't the only culprits guilty of creating an uproar around the countryside. Bailers and other types of harvesting and processing equipment all make a contribution, and Cottrell notes also that irrigation pumps, especially in the southern part of the province, constitute a significant addition.

Farming, however, is only one type of operation forming part of the racket in rural areas. Industry is spreading into more and more small towns and is affecting noise levels in a variety of ways, both directly and indirectly. Recently, the Environment Council held a series of public hearings at several major centres in the province and found, as part of the results, that industrial development is having a noticeable impact on the sound climate in rural Alberta.

"At our hearing on June 23, for instance, we received a brief from a group of farmers outside Lethbridge who had concerns about an asphalt plant in their area which was not only making a lot of noise itself but was causing an increase in traffic on rural roads never meant to carry that volume of vehicles. And of course the traffic was adding to the noise level, too."

Then again, oil and gas operations, as they expand and proliferate, almost inevitably increase the general noise load.

"We have had a number of complaints already about the ethylene plant near Red Deer from people living near enough to it to be bothered by the noise. Actually, it's quite like a lot of other outfits that have sounds such as those made by compressors, whistles, engines, and materials moving through their piping systems. One problem in this line that's very common is gas and oil pumping stations. There are now several hundred of those, mostly in central and southern Alberta, and they can be quite annoying because of the sound the compressor makes. It can be muffled but it isn't mandatory and it's quite expensive to do."

An important consideration in the impact additional noise is likely to have in a rural area is, however, the level of existing sound, points out Gene Bolstad, president of Bolstad Engineering, a company which has been involved in noise studies for several years.

"When we go in to assess the effect a new development is likely to have, we do a baseline study first. This means we have to measure present sound levels. How people will

Lauren Dale

perceive and react to any extra sound does depend, to some extent, on the magnitude of the new noises load relative to the existing 'climate'."

He doesn't feel that traffic noise need necessarily be a major addition, especially if there isn't a concentration of plants all in one area.

"I guess there are pros and cons to putting your pollution, noise and otherwise, all in one place. Sometimes, though, when it comes to transportation of the products of a plant, it may just be a case of adding some more wagons to a freight train service that's already running anyway. A lot depends, however, on what the place is producing and where its employees have to travel from."

Bolstad also notes that many operations now buy enough land to allow for a "buffer zone" so that there is no residential development close to the plant itself.

But seekers of silence often have themselves to blame as well, suggests Cottrell, when they find that their country paradise isn't quite as placid as they thought it would be. Paradoxically, as they drive off in droves to the lake or the mountains, it seems that part of the great escape is to take along a number of noisy gadgets for amusement.

"Trailbikes, snowmobiles, and motor boats all disturb the peace quite a bit. And campgrounds can be bedlam if you have neighbors who insist on playing their radios, particularly late at night."

Noise on lakes and rivers hasn't, he admits, been a big issue with the Environment Council's hearings, but the property owners round one lake at least have a major concern on possible noise increase from another source, according to Gary Faulkner, a professor of mechanical engineering at the University of Alberta.

"Transalta Utilities — that used to be Calgary Power — wants to mine coal right up to the residential area around Lake

Lauren Dale

Noise affects the environment — in cities and in rural areas (where oil and gas operations like those shown below may be especially intrusive)

Wabamun. The cottage owners have organized themselves into the Wabamun Home Owners Association and are opposing the development, partly on the grounds of the noise it would create. Actually, it probably wouldn't be any worse than the sound level you'd get about a block away from a city street, but relatively speaking it would be a significant increase so people see it as a major intrusion."

And even wilderness or semi-remote parts of Alberta aren't as immune to sound invasion as one might think.

"We've had comments from people about planes flying over and helicopters landing in some areas where they'd expected to 'get away from it all'," explains Cottrell. "But I guess what they have to come to terms with is the fact that there really isn't anywhere to go any more where you can be sure of getting peace and quiet. And I don't see any reduction in gasoline-powered vehicles coming, either, in spite of the rising cost of fuel."

For those looking forward to retirement to a sleepy small town, this, too, is turning into an impossible dream as the province opens up and drowsy little hamlets are suddenly prodded into unprecedented activity.

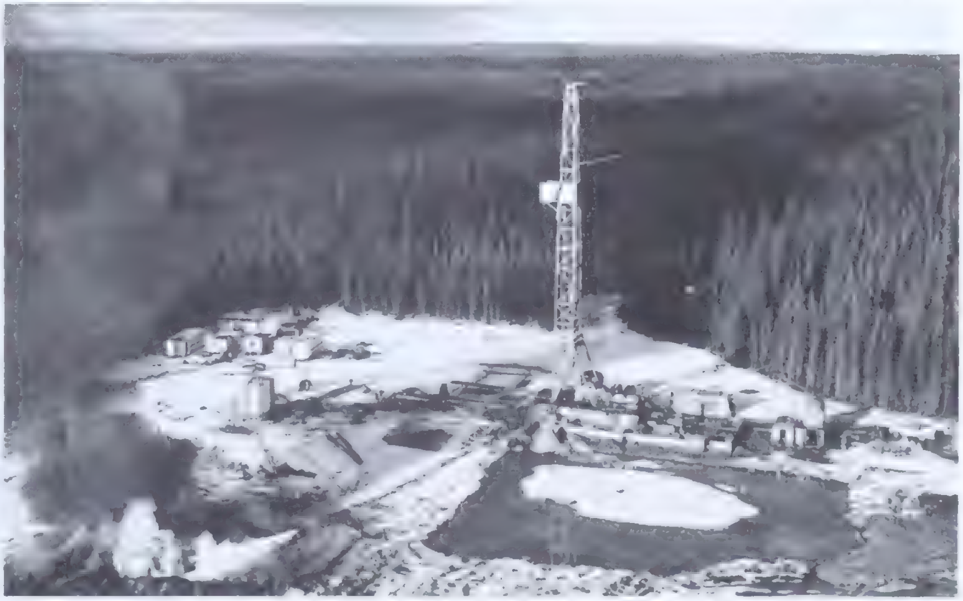
"There's the Redwater region, for example," says Bolstad. "There you have a series of oil and gas complexes two to three miles (three to five kilometres) apart. As a result of this growth, towns such as Bruderheim and Gibbons are beginning to get construction coming in, and transportation to provide essential services is increasing. One study we did showed that there's now a good deal of commercial traffic on secondary roads in the area."

Most Albertans, however, are still only part-time rural dwellers and spend most of their lives in a city or its suburbs where they are constantly exposed to far higher levels of noise than their country counterparts.

Suburbs and commuter towns, which often tend to be swallowed up by larger centres, frequently have noise problems peculiar to their status as dormitories and sources of manpower for adjacent cities.

"Most of the trouble in suburbs is with traffic noise," Bolstad reckons. "And that in its turn comes from lack of foresight and proper planning. People design a housing development, then they put a road in. A few years later, another development goes up a bit further out, and your first road soon becomes a 'feeder' to several sets of suburban expansion and eventually turns into a freeway. Folks living next to it are then getting far more traffic going past their doorsteps than they ever anticipated."

For inhabitants of the city itself, noise is a part of the pattern of urban life, although the individual rarely realizes how much noise is really penetrating his home or how much noise he himself is creating within his own



four walls and — unfortunately — in his own backyard.

"Here again, the single largest source of noise is traffic," says Cottrell. "Almost everybody has some kind of vehicle, so most of us do our share in making the problem, although it's true that trucks are the worst offenders normally."

Some routes with especially high traffic noise are the Macleod Trail and the Glenmore Trail in Calgary, and the Mayfield Road in Edmonton, although this last was recently "insulated" with an extensive sound barrier.

Residents near airports, such as the municipal airport in Edmonton, are also faced with plane noise which can be especially intense during landing and take-off.

"But this is more intermittent than the sound you get from road traffic. Even so, the noise levels reached can be very hard to tolerate."

Sounds heard in the city home are basically of two different types, explains Cottrell, and coping with them should be looked at in two different ways.

"First, there's what's coming in from the outside, such as the barking of your neighbor's dog, the party next door, and the kid across the lane revving his motor bike. If you're going to try to keep that out, you'll need thicker walls, and storm windows, or triple glazed windows, though you can't ever open these. You could, of course, always try to control the noise at its source instead."

Persuading the neighbors to be more considerate may require a major campaign but cutting down on the noise you yourself create should be a good deal easier, provided you're prepared to make a few compromises and become less reliant on mechanization.

"The average house has about 25 motorized devices such as power tools, a furnace fan, and various kitchen appliances. You can reduce your use of these if you want a quieter environment. But kitchens tend to be noisier anyway because they have mostly hard surfaces which bounce the sound waves back. Carpeting and curtains or drapes help to absorb the sound. Then you also have to consider the actual plan of the house. If it's an open plan setup, the noise will travel through a bigger area since there are no doors to help contain and isolate it. For especially problematic parts of the home, you could consider having non-parallel walls — they stop the sound from bouncing back and forward."

In reality, however, home for the urbanite often isn't a single-family dwelling but an apartment, with neighbors more fond of rock music than each other, and walls that contain neither musical harmony nor personal disharmony.

"It isn't quite as bad if the construction is concrete. That doesn't transmit sound as

much. It's woodframe walkups where you'll get the worst problems with noisy tenants causing a disturbance."

The National Building Code regulations, according to both Cottrell and Bolstad, are wholly inadequate when it comes to ensuring a peaceful living environment in high density housing. Bolstad also states bluntly that the government of Alberta has no noise controls *per se*, and describes its enforcement of industrial noise controls as "half-hearted."

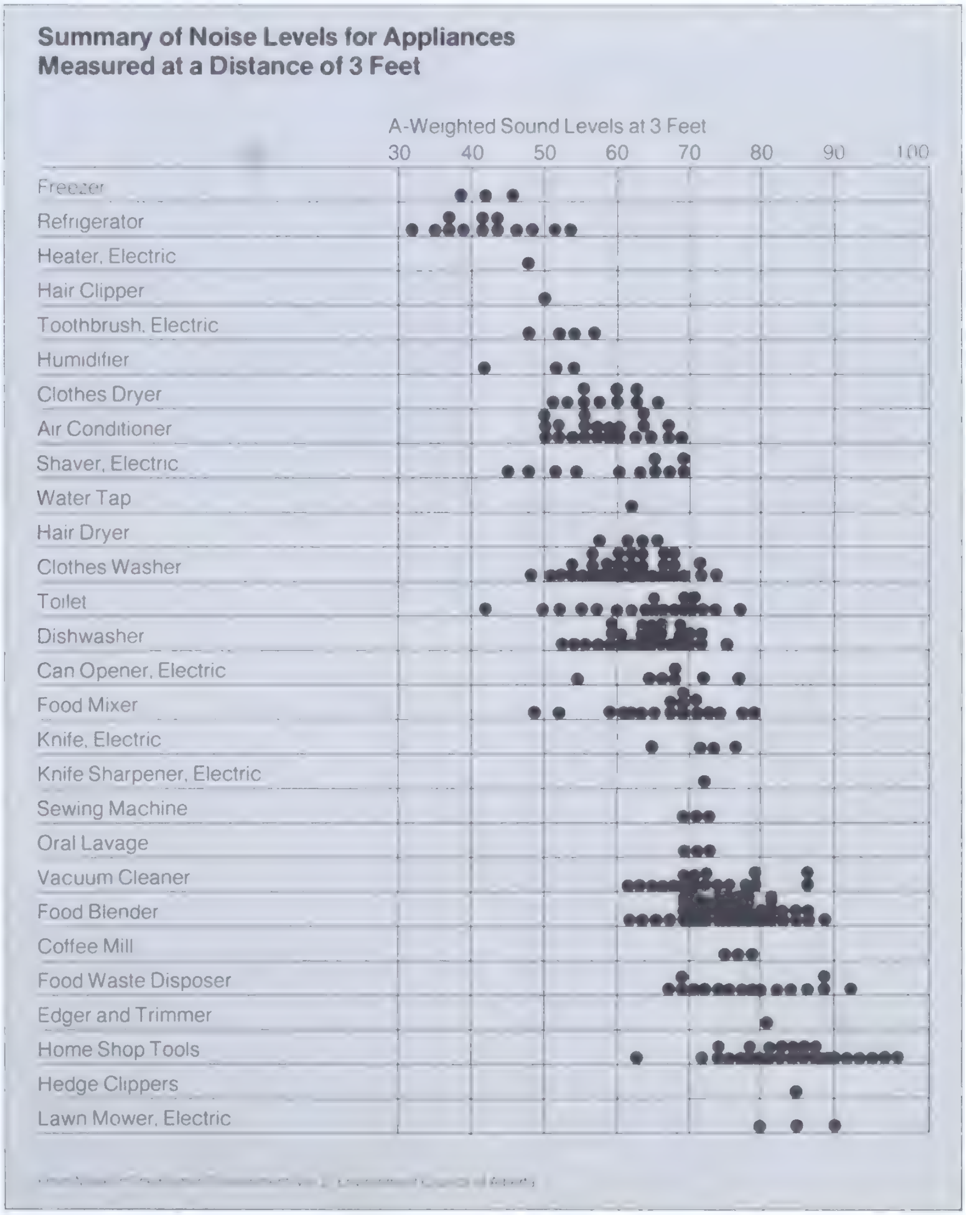
"Right now, 'noise' is just a buzz word in government. There's no real concern at that level yet. That's not to say that the picture is totally black, all the same. There are some builders who are themselves committed to putting up well sound-proofed apartments."

Keeping noise inside and outside the home down to a tolerable level is not, however, a problem which can be answered by rigidly enforced legislation, at least not at the moment, Cottrell feels.

"It's the most prevalent pollution problem there is but people haven't personalized it so far. They haven't realised that the noise they make affects their own health and that of people around them in a variety of ways, so concern with sound levels isn't a part of their value system.

"We're probably at about the point we were with smoking around 15 years ago. In the same way as we've now built up the ethic 'you have no right to disturb me with your smoking,' we have to get people educated into believing 'you have no right to intrude on me with your noise'. Then, and then only, will you get to stick things like laws against playing a stereo full blast out in the street."

Muriel Stringer is an Edmonton freelance writer



Summary of Noise Levels for Appliances Measured at a Distance of 3 Feet

[illegible]

Sharon Adams

Noise As A Health Hazard

'Noise affects everyone, and those having difficulty coping will be affected more.'

Though noise, if loud enough and long enough, can actually be lethal, most North Americans just *feel* as though they're being slowly tortured to death by the cacophony of modern life.

And a kind of torture it can be, too, with health effects of noise pollution ranging from simple irritability, to nausea, to an inability to concentrate and learn, to sleeplessness and loss of hearing.

The most serious auditory effect is noise-induced hearing loss, which takes place over a long period of time, is usually unnoticed at first, and is irreversible.

Deafness has three basic causes: aging, physical damage to the ear drum or mechnical structures of the ear caused by blows or infection, or extended exposure to noise.

Deafness or a degree of hearing loss can be temporary, as in what is known as a temporary threshold shift. That means the ear is temporarily unable to hear sounds it normally can but is able to recover the loss. A permanent hearing loss is called a permanent threshold shift. Usually a permanent noise-induced hearing loss goes unnoticed until the victim's ability to understand speech is affected, and by then the damage is extensive.

To understand how deafness occurs, it is first necessary to know how we hear (see more detailed explanation in accompanying story).

Basically, the outer ear picks up sound waves and funnels them down to the ear drum, which vibrates in response to the sound energy hitting it. These vibrations, with some of the lower frequencies filtered out, are passed through the middle ear and concentrated, or amplified, by the oval window. Fluid in the inner ear picks up the vibration and moves four rows of hair cells, which in turn stimulate nerve endings to send messages to the brain which interprets these messages as sound.

Damage to the hair cells, or their nerve endings, can be caused by extensive exposure to loud noise.

Damage to the 20,000 hair cells in the outer three rows interferes with the ear's "fine tuning" or its ability to suppress noise. This causes painful hearing, poor discrimination of speech, and poor pitch discrimination. These cells are most susceptible to damage by noise.

John Throckmorton

About 95 per cent of the nerves carrying information to the brain originate in the 3,500 inner hair cells. When these cells are damaged, so is the ear's ability to send electric impulses, which the brain interprets as sound.

Hair cells respond to noises much as grass alongside a path reacts to footsteps. The grass springs back up from the occasional footfall, but becomes permanently bent, even broken, with heavy traffic. Temporary hearing loss occurs when the hair cells are "bent" in response to extended loud noise. Hearing is recovered when the cells return to normal.

Permanent noise-induced hearing loss happens when the cells are no longer capable of returning to normal. This permanent loss is stealthy, proceeding slowly and at first affecting frequencies not necessary to understanding speech.

John Throckmorton, co-ordinator of occupational hearing conservation with the medical services branch of Alberta Workers' Health, Safety and Compensation, says noise-induced hearing loss is most often suffered in the workplace. Consequently, the province has instituted a hearing conservation program and noise standards to prevent on-the-job hearing loss.

Unfortunately, Throckmorton's job is complicated because workers must calculate the total exposure at each allowable decibel level, then try to stay within the time limit set. In addition, susceptibility to noise-induced hearing loss varies widely in the population, so even keeping to these standards is no guarantee of protection from hearing damage; those who "bend the rules" may suffer no consequences.

"If you and I were working side-by-side in the same environment" he says, "you could suffer hearing loss and I could be unaffected."

Regular hearing testing is an important component of hearing conservation programs.

So how is a worker to know when hearing is threatened? One indicator, Throckmorton says, is the temporary threshold shift, often a precursor to permanent hearing loss.

"Theoretically, if you don't get temporary shifts, you're not going to get a permanent shift." Temporary shift can be suffered by exposure of 95 decibels — say running a saw — for 15 minutes or more. Temporary threshold shift is signalled by a ringing in the ears and muffling of sounds once the loud noise ceases. It takes about 14 to 16 hours to completely recover from such a shift.

After a few hours, the hearing comes back. But with repeated exposure, the hair cells in the inner ear become permanently damaged, and the temporary threshold shift becomes permanent. When this happens, hearing will not return to normal.

Throckmorton says fear of temporary threshold shifts shouldn't prevent the average person from pursuing the occasional noisy task.

"You can take your chain saw out two or three times a year and probably not suffer (permanent shift), but if you took it out every day . . .

"It's the consistent exposure that makes the difference. As long as the ear completely recovers physiologically, the likelihood of permanent damage (is small)."

Householders, he says, are protected in another way: they tend to move away from noise. If the dishwasher or clothes washer is too noisy, the family moves to another room.

But some workers must remain in a noisy environment. Others, like house construction workers, are called upon to do several different tasks at a variety of noise levels, constantly changing the noise environment in which they work.

Noise-induced hearing loss, unless caused by some traumatic event like an explosion, initially goes unheeded because the loss is confined to frequencies usually in the 4,000- to 6,000-Hertz (Hz) range, unnecessary to understanding speech. This is the range of noisy equipment.

Not until the loss encompasses the upper range needed to understand the consonants in speech, the 2,000 Hz range, is the victim aware of the problem.

First to go are consonants, higher pitched than vowels, so victims complain they hear speech, but can't understand it.

Though those exposed to noise in the community or home environment can choose to escape the noisiest machines, the home exposure may hasten work-related hearing loss.

Dr. Bruce Dunn, a psychologist at the University of Calgary, says by moving from a noisy work environment to a noisy home environment, someone susceptible to noise-induced hearing loss may not be able to recover sufficiently from temporary threshold shifts before having to return to the noisier workplace.

For the rest of us, however, health effects of noise pollution are more subtle. Discounting airplanes and impulse noise, he says, noise around the home or neighborhood is not intense enough to produce the rapid hearing loss to unprotected ears that is found in industry.

But that is not to say community noise doesn't have a deleterious effect on health. In fact, he says, statistics prove that stress-related deaths due to heart attacks and stroke are more frequent in neighborhoods near noisy airports.

Dunn strongly disagrees with those who suggest a 55-dB guideline is a sufficiently low community noise level, because at that level only 95 per cent of speech is intelligible.

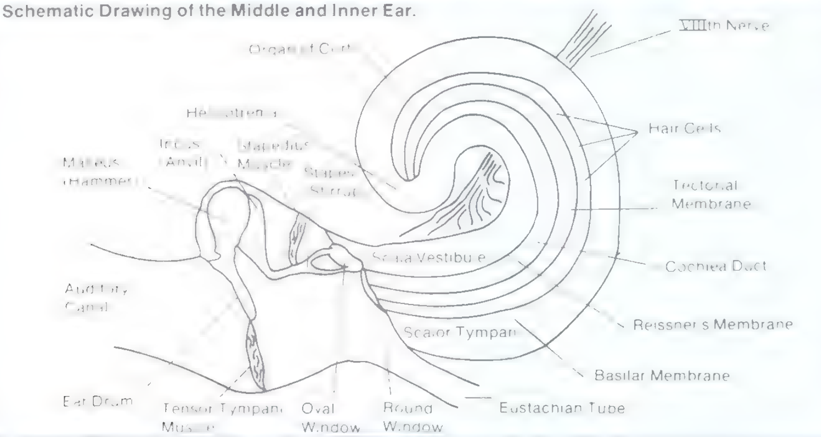
"I say that level is distractive." In normal social situations, he explains, people do several things at once and are not paying strict attention to a conversation. At a barbecue, for instance, the host may be talking while cooking. If traffic becomes noisy or a plane passes overhead, the listeners have to strain to understand what's being said. That strain causes stress.

Though some high-guideline proponents insist speakers simply raise their voices to overcome the noise, Dunn says experiments show speakers do not do so, and "intelligibility drops off rapidly."

Speech interference is an annoyance in

The mechanism of hearing . . .

Schematic Drawing of the Middle and Inner Ear.



What we immediately recognize as the ear is actually only one small part of an extremely complex and sensitive organ which allows us to differentiate the loudness of a sonic boom from the gentlest of whispers, the high-pitched shriek of a tea kettle from the lowest notes on the church organ and the roar of traffic from the strains of a symphony.

The ear is actually made up of three parts: the outer, middle and inner ear. We can see only the outer ear.

The crudest part of the organ, the outer ear acts like a reverse trumpet, gathering in sound and funneling it down to the ear drum through the ear canal. The canal contains hairs which secrete sticky wax to trap dirt, dust and insects before they can damage the ear drum or spread infection to the middle ear.

The ear drum separates the outer and middle ear, and begins vibrating when struck by incoming sound waves. This vibration is carried across the middle ear by three of the smallest bones in the body (malleus, incus and stapes), together known as the ossicles.

These bones are supported by ligaments and muscles, which, in response to the vibration from the ear drum, stiffen the bones and ear drum, thus filtering out some low-frequency sounds. This stiffening causes the bones to move like pistons, allowing the vibration to be carried to the oval window, gateway to the inner ear.

The oval window amplifies the sound much as a magnifying glass concentrates light to generate heat to start a fire. It is this amplified sound which is transmitted to the inner ear.

The inner ear is made up of three chambers: the cochlea (hearing organ) and the semi-circular canal (balance organ), connected by the vestibule.

Balance is an important part of the job done by the inner ear, and explains why a hearing test can often determine why a person suffers dizziness.

The inner ear is filled with a fluid called perilymph. When sound vibrations pass through the oval window, this fluid picks up the motion, much the same way as ripples are caused by the impact of a pebble on a pond surface.

The hearing organ (cochlea) is lined with a delicate, sound-sensitive basilar membrane which has four rows of hair cells. These cells bend and sway in sympathy with the movement of the lymph fluid. This movement stimulates the auditory nerve, which in turn produces electrical impulses which are transmitted to the brain where they are interpreted as sound.

Sound has two characteristics: intensity and frequency (loudness and pitch). To distinguish all the combinations and permutations of pitch and loudness, the inner ear must behave as an acoustical acrobat.

Researchers do not agree on exactly how this is accomplished, but most agree pitch is determined by the basilar membrane, which vibrates more strongly at some points than others in response to particular frequencies and the pattern of electrical impulses given off by the nerve endings.

How we distinguish loudness is less well understood, but it is known to vary with sound energy and frequency.

Hearing can be affected by a number of physical or physiological events. A box on the ears may stimulate the auditory nerve and cause ringing in the ear. The inner ear and auditory nerve can be damaged by infections such as scarlet fever and measles, blows, swimming and diving, change in pressure within the ear and high blood pressure and rheumatic ailments as well as noise.

most community situations, but noise is a stressor that can cause or exacerbate health problems.

Blood pressure increases with noise level, even in persons who claim to be unaffected by noise, and experimenters have recently found changes in hormone levels and blood cholesterol with exposure to noise at levels below those associated with high hearing loss risk.

The body *physically* reacts to noise, alerting its "fight or flight" defence mechanisms. Dunn reports in an Environment Council of Alberta background paper the body's defence against high levels of noise stress may itself be dangerous, leading to exhaustion that shows up as ulcers or kidney breakdown.

"There are considerable gaps in our knowledge (of health risk from noise)," he notes.

Tim Beer

No work has yet shown a link between noise and man's mental health, Dunn reports, but animals under stress from noise have been shown not to cope with environmental frustrations and suffer psychic damage.

Recent experiments reported in the June issue of *Discover* magazine showed children who lived directly under an air corridor of the Los Angeles international airport, which sent planes overhead on an average of every 2½ minutes during the school day, had higher blood pressure than a similarly-aged group from a quieter neighborhood.

In addition, the 142 third- and fourth-grade students exposed to the noise were less able to solve puzzles in school — even when they were protected from noise outside for part of the day while in the class.

A particular concern with chidlren in noisy environments is that they may have problems learning the language, Dunn reports. Since they already have a poorer grasp of sentence intelligibility than adults, they must depend more on understanding each word individually. Noise may interfere with speech acquisition for them, and for adults learning a second language.

Even adults, though, have more trouble performing tasks under noisy conditions. Dunn explains that as the body's defence mechanisms become aroused, attention narrows, making it easier to perform simple tasks, but increasing the difficulty of performing tasks in which the worker's attention is spread over several things — as in listening to a lecture or speech and taking notes.

As tasks become more difficult under noise stress, so do our relationships with each other, he says. As noise increases, people become more aggressive and less helpful.

In one experiment, he says, a normal person and a person wearing a cast were asked to drop a load of books on the street. In a calm environment, passersby helped both retrieve their books, with 80 per cent responding to help the person in the cast. But when a noisy lawnmower raised the noise to 87 dB only 15 per cent of passersby offered to help even the person wearing a cast.

Noise can not only keep a person awake for a longer than normal period; it may also prevent the sleeper from getting back to sleep — especially early in the morning. Recent research shows the importance to health of uninterrupted sleep. Lack of sleep, ironically, can make a person respond with stress to frustrations — like noise — the next day.

Because individuals react differently to noise, and because each of us may react differently to the same noise at different times, and because there are such large variations in individual susceptibility to noise-induced hearing loss, it is difficult to determine "safe levels" of noise exposure.

"People who are having a hard time coping, are going to have a harder time coping in high noise levels," Dunn said. "We can't work on the assumption we're dealing with healthy, well-adapted people when we set noise guidelines. We have to realize that noise affects everyone, and those having difficulty coping will be affected more. I mean, everyone has days when they feel they can't cope with tomorrow."

Though there is a dearth of evidence of health hazards of noise, he reported to the ECA, "nonetheless one cannot assume the lack of data represents the absence of risk."

"If in doubt," he said, "I advise to err on the side of caution."

Sharon Adams is a journalist in Calgary

Jack Spearman

In The Workplace

Three men talk about on-the-job noise.

Occupational noise is the most common and prevalent health hazard in the workplace.

So says John Throckmorton, co-ordinator of occupational hearing conservation with the medical services branch of Alberta Workers' Health, Safety and Compensation.

Of Alberta's approximately 800,000 workers, 185,000 (including 60,000 farmers) are exposed to noise levels sufficient to cause some degree of hearing impairment with overexposure.

Among the worst occupation and industry offenders, in terms of sound levels and exposure, are heavy equipment, power-actuated tools, oil well drilling, mining, sawmilling, boiler making and drop forge operations, says Throckmorton.

The province has instituted a hearing conservation program and noise standards to prevent on-the-job hearing loss. But implementation isn't always easy.

Workers have been known to object to wearing hearing protection on the job, while their employers may balk at the cost of providing it. And cost may be a valid consideration where a transient labor force makes long-term benefits difficult to obtain.

The stories that follow of three men, with different work histories, can read as cautionary tales to those who may still doubt the hazards of a noisy work environment, and the need to do something about it.

John Green

"We call this place Sleepy Hollow because it's such a good spot to take a quiet snooze," joked farmer John Green while looking out the front window of his farm home, curled in a dip in the rolling prairie near Blackie, Alberta.

It's a paradox, the peace and quiet out here. On the surface, it's a haven where any city dweller whose ears are constantly assaulted by the urban cacaphony of street and construction noises can hear every twitter from every bird and the whistle of the wind, so it seems, through every blade of grass.

But the truth is that modern, mechanized farming is so noisy that the years of riding tractor and combine have robbed Green of enough hearing to give him a social handicap.

Maureen Murphy of Alberta Medicorp Ltd. has been involved with a hearing testing program for farmers that Alberta Agriculture has sponsored for the past two years. Conclusive statistics have not yet been compiled from the data, and such factors as a farmer's age and heredity enter the picture. Nevertheless, said Murphy, there are a "significant" number of farmers in this province who have been found to have some sort of hearing problem.

A tractor without an insulated cab will produce about 96 decibels of sound, a level in industry that workers would not be expected to sustain for more than two hours without a break. On a farm, when there's a crop to seed or bring in, there's no such thing as a break every two hours.

On a farm, it's not constant exposure to noise that does the damage, it's protracted exposure several times a year.

"We put in long, long days on tractors or a combine," said Green. "When there's a job to be done, it gets done. You're the only person around to do it so if it means 14 and 16 hours a day on that tractor, you do it," he said.

Green, now 60, has been farming all his life like that. And while the ear experts would call the noisy throb of farm machinery noise, it's the sound of business as usual as far as Green is concerned.

"You have to listen to the noises your tractor makes to know what's going on," he said. "If something is wrong, if there's a slight change in the hum of the machine, it tells you something might be going wrong." Down time in a business that depends on the weather and daily fluctuations in commodity prices is something no farmer can afford, he added.

Green's current tractor has a sound-insulated cab on it, complete with radio and air-conditioning. It's quieter and more comfortable for sure, but for a farmer who grew up listening to every gear clatter, there's a feeling of isolation. Green doesn't like the idea of depending on a panel of warning lights in the cab to tell him something on the tractor isn't working just right.

But much as farmers like to be self-reliant, they are also quick to adapt.

Green realized he was losing his hearing years ago and when the first tractors with cabs came out, he got one. Unfortunately, earlier models were so poorly designed that the glass in the windows vibrated. Poor insulation made them act like the sounding box on a guitar.

A few years back, Green's daughter presented him with a pair of industrial ear protectors which he now wears regularly. He said farmers in general are now more aware of problems implement noise can cause their

health and it is quite common now for farmers to wear ear protection.

Green has never had his hearing formally tested, although he did attend a service club meeting in Blackie several years back when an audio testing unit was brought in for the evening. "I knew I was getting hard of hearing . . . they hooked that machine of theirs up and then they hooked me up to it. The graph that comes out the end is supposed to look like a mountain. Well, mine was more like a mole hill," he said.

Green does not consider himself to have a handicap with his hearing, although with a little prodding, he will use the word.

For most people with a form of noise-related hearing loss, certain high frequencies in the speech levels go first — these are the frequencies for such high-pitched, soft consonants as p's and t's which are made by forcing pops of air through the teeth or off the roof of the mouth.

Green can hear just fine in a normal room with only one other person talking, but in a crowded room or at a gathering where there are other sounds competing for his ear, it's a different matter.

"I can't tolerate noise coming from behind me . . . when I go to a party, I always get myself along a wall. Otherwise, I pretty much have to have my ear in somebody's mouth to hear them.

"I don't consider it to be a handicap most of the time. But I guess I would have to call it a handicap socially. It forces you to be anti-social, not because you are but because you have to be.

"But each occupation has its hazards. The younger farmers are a lot more aware now, but when I started out, it just wasn't a concern . . ."

Ed Jenkins

Ed Jenkins might have thought twice about that after-school job as a pin monkey in the bowling alley had he known where it was going to lead.

"That was back during the war on weekends and after school," said the former heavy equipment operator. "I guess my working life was noisy right from day one."

Jenkins wears a hearing aid now and is a dispatcher in the Edmonton office of the Operating Engineers' Union where the noisiest aspect of the job is a steadily ringing telephone.

In his case, there is no doubt that on-the-job noise caused his deafness. In the early '70s, after three appeals, the Workers' Compensation Board ruled that way and now pays for his hearing aid and related supplies. He was one of the first workers in the province to claim hearing as a job-related disability.

Jenkins' work history reads like an ear-shattering epic. After the bowling alley, he started working around caterpillar tractors shortly after the war. By 1948, he was manning jack hammers and compressors and then, a few years later, worked on heavy equipment in rock pits.

"All that equipment was just terrible," he said. "About the only protection for our ears back then was in the winter when we'd wear ear muffs or something to keep warm . . . but that was the way I worked for 15 and 20 years."

Operating engineers work mainly in the construction industry on such noisy pieces of equipment as jack hammers, pile drivers, caterpillars, and cranes. The work day varies with the construction season, but weather permitting, the days on the job can stretch well past eight hours.

Jenkins first noticed his hearing starting to slip about 20 years ago. His left ear — the one that faced the machinery as he sat in the operator's cab, went first.

At one point, when he was working on compressors in power houses, he said he was issued ear plugs. "I wore them for a while," said Jenkins, "but I never did get in the habit. Lord only knows I should have."

Ten years later, he was at the WCB. "I suppose trying to prove you lost your hearing on the job is like trying to prove a back injury," he said. "But my doctor and I just kept going and finally, we got the case approved."

As in all areas of occupational health and safety, there has been a growing awareness among operating engineers of the dangers of worksite noise, said Jenkins. Hearing aids are covered under medical benefits and many workers now carry their own ear protectors to the job.

But Jenkins said enforcement of ear protection rules is up to the contractor and can vary from site to site. "I don't think they're doing all they can to enforce it . . . you can go on to a job site and see men without their protectors. When I see that, it really makes me wonder." And despite advances in technology, Jenkins doesn't think the new generation of construction equipment is much quieter than the old. "The manufacturers are separating the cabs a little more from the

The pressroom at the *Calgary Herald*.

machines and there is more padding in the cabs . . . personally, I think they could be doing more. In the old days, you could hear clutches in some of the old draw equipment squeal for a mile. They've been replaced by hydraulics now, but you can hear them squealing a mile away too."

Jenkins' attitude too is that noise was part of the game when he got into operating heavy equipment. "At least since I got the hearing aid, it hasn't gotten any worse. I think that at home on the weekends, I could almost do without it.

"But I do wish we had known a little more earlier on. I did get off to a bad start."

Ken Brown

Presses for daily newspapers are huge machines, three storeys tall and half a city block long. And when they wind up to crank out 40,000 copies an hour, the noise ricochets off cement floors and concrete block walls into a droning, noisy hum.

This has been the working environment of Ken Brown, pressroom foreman of the Calgary Herald, since he started in the business in 1945; in all probability, it has contributed to his partial loss of hearing.

Like farmer Green and operating engineer Jenkins, Brown has trouble following a conversation if there is any background hubbub. "If I go to a social gathering and can't hear properly, it makes a person feel kind of dumb," he said.

"And there are some people with voices that I just can't seem to hear. The assistant foreman has a voice like that. I sometimes have to ask him to repeat things for me."

Ear protectors are standard equipment now in the pressroom. But before 1965, there was nothing, said Brown.

"We all felt the noise came with the job. We didn't care about it very much.

"Oddly enough, you get so that you like the noise. You get so used to it after a while that you're barely even conscious of it."

The noise in the pressroom pushes 100 decibels at the end of the press where the rolls of newsprint are cut and folded into individual newspapers, said Brown. That's a noise level that keeps up on an average day for four hours — longer on Fridays and weekends when the paper is larger and more copies are printed.

About 10 years ago, as awareness of the hazards of pressroom noise grew, the paper instituted a program under which noise levels were monitored and workers' hearing was checked, said Brown. The most recent hearing tests seem clearly to link noise and hearing deterioration.

Of 69 employees, nine were urged to see a doctor; eight, including Brown, were told wearing ear protection was "imperative" to prevent even more loss; another 20 were described as having lesser amounts of hearing loss; while the remaining 32 had normal hearing.

"The company takes these findings seriously," said Brown. "There has been very little resistance to this program and the men are at least clearly warned what could happen as a consequence . . . I'll give a man time off if he needs it to follow up on the tests."

Some press rooms, he said, are now equipped with "quiet rooms" where pressmen can go for a break from the constant din of the press. "Our men haven't asked for one here, but I'm sure the company would go along with one if it was requested," said Brown.

In addition to regular shifts, some pressmen also have the chance to work double shifts on the weekends. "They leave here and their ears will be ringing . . . but that's a choice the individual man can make.

"Sure it's noisy out there to somebody who isn't used to it, but even at its noisiest, there'll often be some guy in there whistling while he works."

Jack Spearman is a journalist in Calgary

Susan Mayse

The Damage In Dollars

As with any pollutant, we have to pay for our noise excesses.

Silence is golden — and these days anything golden costs plenty. Quiet, which we once took for granted, now adds up every year to million-dollar expenses.

Unwanted noise we've all encountered – the guy across the alley who repairs jackhammers, the kid showing off a new radio in the park, the Friday after-work traffic jam. The home vacuum cleaner all by itself constitutes a vortex of noise pollution. But few people have encountered the idea that noise pollution comes with a price tag.

Noise exacts its costs in real-estate prices. In alcoholism and family disintegration. In lost on-the-job productivity, compensation claims, full and irreplaceable hearing loss. Each indicates the value of silence, because each costs us measurable amounts of money either individually as in house prices, or collectively as in city road-quietening projects.

That's the theory, anyway. In practice the accounting is more difficult, says Tom Cottrell, a research officer with the Environment Council of Alberta who has been working on noise pollution.

"It's an extremely difficult area to attach costs to, to attach figures to, probably because there's not a lot of economic evaluation that's been done on noise — because it's indirect.

"It's easy to say how much it may cost someone to have a back alley paved — it's more difficult to say how much it would cost them as an individual to make the road where they live quieter."

Yet it's worth making the effort to identify costs of noise pollution, and benefits from reducing it, in easily-grasped financial terms. For one thing, it makes the problem real to people — noise-producers, noise-irritated homeowners, taxpayers — who may never have stopped to think of excess noise as pollution.

"What we're trying to do with noise is that we're trying to battle the gradually increasing level of noise in our communities," says Cottrell. "The level of sound in our communities has been rising by about one decibel a year," he adds, shouting over a concrete drill threatening to burrow into his office from the next floor down.

"What's happening now is that our understanding of how significant noise is, is growing — we realize that it's probably much more serious a problem than what we have believed up to this point."

Attempting to attach dollars-and-cents values to noise pollution in Alberta, the ECA hired consultants — InterGroup Consulting Economists Limited of Winnipeg — to carry out a study. Their report, *Economic Aspects of Noise in Alberta,* released last year, based its information on real estate figures, provincial and federal health statistics, reports from the now disbanding American Office of Noise Abatement and Control, and others. The results are sometimes startling, but they all add up to the same concept. Either as individuals or as a society, we pay dearly for our peace and quiet.

Benefit-cost analysis is the study's main tool in analyzing economic effects of noise. Can such analysis work?

"With better data, successive approximations can be improved, thereby giving policy makers more accurate information on which to base decisions about noise control," suggests the InterGroup study.

Benefit-cost analysis offers a framework for presenting the known information – and by implication, pointing out what isn't

known. As well as providing information for political or individual decision-making, and projecting costs and benefits for noise policy purposes, benefit-cost analysis permits comparison of approaches to any particular noise problem.

What then are the costs and benefits?

Some are so diffuse and tangled with other factors that they can't be assessed, but this leaves several readily-defined areas: the workplace, consumer products, the home.

Alberta's minimum loss from traffic noise in residential capital value is estimated at $350 million, or $26 million annually. A further $100-150 million capital value, or $15 million annually, derives from air transportation noise.

Cottrell offers the example of two similar houses located in neighborhoods with different noise levels. "The one in the quiet area is going to be worth more on the real estate market than the one in the noisy area."

Selling price is easily calculated, but there are less concrete side-effects which may also be at work. For example, houses near an airport or main road may not be landscaped as fully, may not be developed or maintained as well as houses in quieter areas. Because of the noise levels among other factors, people simply care less about their homes.

Buyers pay a premium for a house in a quiet residential zone — at least, buyers who can afford to pay.

"But the people that live there (in noisy areas) are people that perhaps are less capable economically of moving to a quieter area. They may not have the versatility in job skills — they might not be able to quit their job for fear of not being able to get another one — they can't afford to move."

In residential districts, transportation is the main cause of noise pollution — in places the sudden extreme noise of jet take-offs and landings, but more often the all-pervasive background roar of road transportation. The main culprits are heavy trucks.

Several methods can reduce transportation noise. The City of Edmonton recently erected a five-metre steel noise barrier on Mayfield Road, at a cost of a million dollars, to reduce the decibel level for homeowners near the road artery. The U.S. Noise Abatement and Control Office studied the cost of making quieter trucks. Cities across North America have investigated costs of including quiet in future works projects.

Edmonton has completed the first stage of a three-part report into the cost of making future road systems and adjacent residential areas quieter than existing road systems. Costs and benefits of three sound levels were considered for a road system similar to the Whitemud Freeway. At 55 dB in adjacent residential areas, capital costs were estimated at $37 million; at 60 dB, $18 million; at 65 dB, $5.8 million.

Homes near the road system would be quiet, but the high capital outlay would do nothing to alleviate sound pollution in existing neighborhoods, just as after-the-fact noise barriers offer strictly local benefits.

The ECA also considered the cost – established by the U.S. department of transportation — of retrofitting heavy trucks with noise-reducing equipment including quiet mufflers, clutch fans and engine shields. All the heavy trucks in Alberta, about 60,000 altogether, could be retrofitted at a cost of $500-800 per truck.

"The economic benefit of making the trucks quiet goes everywhere the trucks go, including to the driver," says Cottrell. "The cab of a truck is the truck driver's work place. If that level is higher than 85 decibels over an eight-hour period, he has to wear a hearing protector. And he probably doesn't.

"What that tells me is that the most economical way to control noise is controlling it at the source by making the products quieter. If there's no demand from the citizens of the country or the province to use quiet products, the manufacturers won't

Noise pollution costs money, whether it's spent on a hearing aid or a barrier against traffic noise

Tim Belec

respond by making quiet products. Either manufacturers make quiet products through government regulation or by consumer demand."

Retrofitting aircraft is less practical, because of high capital costs added to high lost-time costs. Fitting a single DC-8 with noise-reducing equipment, for example, would cost $1.8 million, plus $150,000 in lost time. Air traffic noise is more effectively and cheaply reduced with land use control and design of new buildings, at a cost of about $5,600 to insulate a new home.

"With noise it's cheaper to build quiet products than it is to try to deal with the noise source by retrofitting or controlling the noise along a pathway as with the noise barrier," says Cottrell.

Noise in the workplace offers some of the most easily-defined costs, since it produces reasonably well-defined problems. Some workers lose all or a proportion of their hearing — temporarily or permanently but many more experience illness and stress-related family and social problems that can be attributed directly to high-noise jobs.

"Potentially 250,000 people in Alberta are exposed to intense noise in the workplace," says the ECA's pamphlet *Noise — Economic Aspects*. "These impacts are estimated conservatively to cost $65 million per year."

In 1979, Alberta paid out $58,000 in 13 accepted claims to workers suffering hearing loss — an average of over $3,000 per claim. Larger amounts are paid in the U.S., where greater recognition is given to the actual market value of hearing loss.

"That's a lot of money when you think that probably for a cost of $20 an employee, an employer could provide hearing protection which could help prevent people from going deaf, thereby preventing claims by employees for hearing loss."

Industry itself bears probably far greater costs through lost productivity, absenteeism, turnover and low morale, although the InterGroup report says this aspect is difficult to document. A U.S. study estimated the cost to every employed American as $60 in 1971. Noisy work conditions may also bring about 1.7 more on-the-job accidents per worker per year than quiet plants.

Although Alberta workers are required to wear hearing protectors in jobs with noise levels over 85 decibels, Cottrell feels the regulation is "not enforced as well as it could be," since rigorous enforcement would require more inspectors hired at taxpayers' expense.

"There's no question that the cost of controlling the noise is far less than the cost of dealing with those problems, and the costs those problems create."

Industrial noise can be controlled at the source, along the noise path, or by protecting the recipient. All are feasible, with different price tags attached to reducing noise to different levels. A 90-dBA level achieved through engineering and retrofitting could produce a present benefit worth $500 million, also at a cost of about $500 million, phased in over the next five to 10 years.

"In 20 years we may all need hearing aids," says Cottrell. "What we have to do is use artificial earlids. But we have to create an awareness for the use of artificial earlids, and also an awareness to reduce the noise."

Some stigma is attached to the wearing of hearing protectors in the workplace, says Cottrell.

"It's not considered a macho thing to do. I think when the use of hard hats was first promoted it was much the same thing. But hard hats are universally accepted now. We have a growing awareness among workers to wear hearing protectors — I think it'll come."

Noise pollution at home is less expensive partly because it's a less definable proposition.

"It's simply a function of the way people live — if they choose to have a noisy home, it's going to cost them money. In many cases we don't have quiet products on the market."

Cottrell cites the story of the manufacturer whose quiet vacuum cleaner failed to sell. People didn't believe a silent vacuum cleaner could be efficient, and went on buying noisy products.

"If we can persuade people that they should buy quiet — that they should buy a product that's quiet in preference to a product that's noisy — that they should promote quiet behavior among people as opposed to behavior that's noisy — we can do a lot to make our society quieter.

"If we can make it a function of consumer demand we don't have to make it a function of government demand.

"If the city of Edmonton preferentially chose to buy machinery, equipment, tools, typewriters, chain saws — if they preferentially wrote in their specification that they wanted equipment that met a certain noise level or was quiet, manufacturers in no time flat would be responding.

"As it is now, there isn't a demand for quiet."

Susan Mayse is an Edmonton freelance writer

Norma Ramage

The Law On Noise

Mostly it fails to solve the problems.

When Edmontonian David Goa's neighbors started having all-night parties with their stereo turned up to ear-shattering levels, he didn't know what to do.

Polite requests to turn it down were met with suggestions "to do the biologically impossible," says Goa.

Finally, he hit on a solution. A quick search of the land titles revealed the house was rented and also provided the name of the landlord. After that, every time the partygoers cranked up for an all-night revel, Goa and various neighbors took it in turns to call the landlord in the wee, small hours of the morning and invite him to the party.

The urban guerilla tactics worked. Within a month the noisy neighbors had been evicted, and, says Goa, "blessed peace and quiet returned."

But not everyone has the initiative or combativeness to resort to Goa's tactics. For those who don't want to, there is a growing body of laws, regulations and bylaws to protect them from noise pollution.

The laws are becoming more numerous, but according to some legal and environmental experts, they have a long way to go before they can effectively deal with what is rapidly becoming one of North America's and Alberta's biggest pollution problems.

Although there are more anti-noise laws today than ever before, they are nothing new. It seems that as long as there has been noise, there has been some sort of regulation to try and control it.

Even ancient Rome had a noise bylaw on the books. The Senate banned chariots from some areas of the ancient metropolis because of the racket their metal-rimmed, wooden wheels made.

But it was the Industrial Revolution and its attendant massive increase in noise that really started the move toward more comprehensive controls, says John McLaren, dean of law at the University of Calgary.

Unfortunately it was also the Industrial Revolution that provided the first evidence that lawmakers could not produce regulations which could effectively deal with the problem.

"During a period of unbelievable economic growth, aggravated by constant pressures to expand industry and improve employment opportunities, it is not surprising that bylaws relating to noise were fitfully adopted and indifferently enforced," McLaren says in a background paper produced for the Environment Council of Alberta.

Laws fell further behind reality when two developments in the middle of this century sent noise booming beyond all previous limits. Lawmakers found themselves scrambling to come up with regulations that would deal with the new high decibel racket created by mass use of cars and trucks and by the introduction of the jet airplane.

Gradually, says McLaren, some steps were taken to remedy the problem, most notably the introduction of zoning regulations to keep high-noise industrial plants out of residential areas.

But the law is still playing catchup, he says, applying only "band-aid solutions" that fall short of solving the real problems.

In Canada, one of the major difficulties is the lack of national noise standards and a national noise reporting system. Almost alone among Western industrialized countries, Canada parcels out jurisdiction to three levels of government, causing confusion both for the lawmakers and for the long-suffering public.

For example, imagine that you're a Calgarian bothered by the sound of low-flying jets. Who do you complain to? The airport is owned by the federal government, but the airspace the plane flies through is a provincial responsibility.

And to confuse the issue totally, your house is within city limits and subject to municipal laws.

Although the powers of the three governments overlap there are some basic guidelines to who regulates what, says McLaren.

The federal government's jurisdiction over noise parallels its control in other areas. For example, the federal government is respon-

Police monitoring of noise levels (far left, and below).

sible for governing noise connected with navigation and shipping, interprovincial rail lines and for interprovincial transportation and communication noise in general. It also regulates noise levels originating on federal lands such as major airports.

The province's primary area of regulatory control is over noise in the workplace. In Alberta, the provincial government has delegated much of its regulatory powers in other areas to municipal governments under the 1974 Environmental Protection Act.

The problem with that move, says McLaren, is that the ball has been dumped suddenly and squarely into the municipalities' court. They are left to decide what, if anything, they want to do about noise by-laws. The result has been a number of municipalities with no noise regulations at all.

And even where by-laws have been passed, McLaren doubts their effectiveness.

"To date, municipal regulation of noise has had little effect in reducing noise levels," says McLaren in his ECA paper.

"Furthermore, municipalities, which often lack the financial resources to make it possible to enforce the laws vigorously, are not assisted by the parsimony of their provincial masters."

However, some of the province's larger municipalities, notably Edmonton and Calgary, have passed comprehensive noise by-laws in recent years.

The Calgary and Edmonton by-laws are similar. Both deal with acceptable decibel levels for motor vehicles and permitted noise levels in residential, commercial and industrial areas.

This short list encompasses a multitude of cacophonous sins. Taking Calgary as an example, the section on domestic or residential noise, among other things, prohibits your gung-ho neighbor from getting up at 7 a.m. on Sunday, plugging in his lawn mower and attacking his grass and your slumbers.

The commercial section deals with the hours heavy trucks and other commercial vehicles can legally be operated in a residential area. In the main, their operation is restricted between 10 p.m. and 7 a.m. The regulation can even be invoked to stop the milkman who noisily unloads his bottles, disturbing your sleep at 6:30 every morning.

The by-laws have a special section dealing with construction noise which prohibits builders from using noisy machines between 10 p.m. and 7 a.m.

The motor vehicle section sets maximum limits for the sound produced by almost any motorized vehicle from a moped to a diesel semi-trailer. For example, in Calgary, maximum allowable noise intensity for a passenger car travelling at 50 kilometres an hour is 80 decibels and for a tractor trailer at the same speed, 92 decibels.

With such incredibly detailed and apparently comprehensive laws, the citizens of Edmonton and Calgary would appear to be uniquely blessed by living in a haven of peace and quiet.

Not so. In fact, decibel levels in both cities have been increasing for the past few years. In Calgary, for example, the downtown noise levels vary between 65 and 70 decibels, according to a recent study by city transportation planners. That's not as bad as New York, but it's noisy, say city transport officials. They expect Calgary will be twice as noisy within 10 years if curbs aren't applied — on traffic noise in particular.

So despite the impressive array of regulations and the equally impressive number of machines available to track down and measure noise, there's still a major noise problem in most Alberta cities.

One of the main causes of this lingering problem, police, environmentalists and planners agree, is enforcement.

"Making the law stick, making it work, that's the big headache," explains Keith Campbell, Calgary's chief by-law enforcement officer.

"These guys, these lawyers who write these (by-laws) with all their literary diarrhea don't stop to think how hard it is going to be to make it stick in court."

He uses as example a section of Calgary's by-law which states that domestic noise must

CLIMB EVERY MOUNTAIN
The noise is worse than I thought...send up a *larger* watermelon.

disturb "the comfort, repose, health, peace or safety of others" to be illegal. Campbell says it's not clear to him whether it would have to be proved that all these things were happening or only one of them.

Another enforcement problem comes in getting witnesses to testify that the noise bothered them. While people are ready enough to call and complain about a noise, they often balk when faced with a time-consuming court appearance, says Campbell.

Superintendent Phil Crosby-Jones of Calgary's city police identifies another problem universally shared by police forces trying to enforce noise by-laws.

"The sanctions, the fines, just aren't strong enough usually to be a deterrent," he says, pointing out that in Calgary, the maximum fine under the by-law is only $500.

Such a fine wouldn't do much to shut down a noisy overnight cement pour on a construction site where the contractor stands to save thousands of dollars by working extra, illegal hours.

Noise by-laws are also difficult to enforce in terms of available police manpower. Using noise meters on traffic, for example, takes a lot of time for little return. The result, says Campbell, himself an ex-traffic policeman, is "those noise meters go into the trunks of police cars and stay there for years."

Crosby-Jones admits police response to noise complaints may not be as prompt as the public would like. "We priorize calls and noise complaints may go far down the list behind more serious, criminal complaints."

As a result, police generally don't enforce noise by-laws on their own initiative, but act only when pushed by the public. However, says Campbell, if citizens are determined enough that pushing can be effective.

A good example is the recent Calgary police crackdown on noisy parties. Incredible numbers of complaints led the police to announce a get-tough policy, says Crosby-Jones.

However, even here the by-law can be difficult to enforce and police often resort to a charge of obstructing a police officer when rowdies fail to break up the party.

People like Campbell and Crosby-Jones aren't sure what can be done to improve anti-noise by-laws. But noise expert Gary Faulkner says nothing can really improve them and it's a waste of time trying.

"Noise by-laws are only a means designed to remove the immediate worst offenders, they're not a long-term solution to finding a quieter society," argues Faulkner, a mechanical engineer at the University of Alberta.

"What we need is pre-planning to cut down noise in the future. It's no use coming after the fact and trying to do something. It's too late and nothing can be really effective."

Faulkner backs up his point by using the example of Leduc, a small town just south of Edmonton.

"The people in a subdivision there are sitting right on Highway Number Two and the noise is incredible. But what can be done about it now? The only solution that will work is closing down the highway and that's impossible. Somebody should have thought about that problem before those houses were built. Now it's too late to do anything practical."

To prove that pre-planning can be effective, Faulkner points to the example of the aviation industry.

"When jets first started flying in large numbers in the early 1950s, the numbers of complaints from people living near airports was incredible," says Faulkner.

"So right then, the U.S. government, instead of looking for some band-aid solution, started setting out regulations that would make the engines of new jets quieter."

Anybody living near an airport can testify to the success of this policy. Today's giant 747 jumbo jets are much quieter than their smaller, older brothers, the 737s. And under the spur of federal regulations, the industry is coming up with a new breed of ultra-quiet planes like the DASH prop jet now operating between Edmonton and Calgary.

In his ECA paper, McLaren takes the same tack as Faulkner, emphasizing the need for some forethought and for joint action by all three levels of government to reduce noise pollution.

"Although the noise by-law may work effectively in limiting noise from existing sources, it is a blunt instrument for building noiselessness into the construction or manufacture of buildings, machinery, vehicles and appliances.

"If the long-range objective is a progressively less noisy environment, this type of built-in control would seem to be all-important."

McLaren believes that with a tougher, more integrated approach the problem can be solved.

If he's wrong, it may lead to an upsurge in urban guerilla tactics from frustrated victims of noise pollution. Sufferers like one Calgary man whose neighbor refused to stop revving his car for 10 minutes before he left for work at 4 a.m. His solution was to stick a potato up the car's exhaust pipe. That ended the noise — and the car.

Norma Ramage is a journalist in Calgary

Jenny Hughes

Berms, barriers and quieter trucks help in

Turning Down The Volume

You're just nodding off to sleep when a truck rumbles by the open window. Or you can't hear your favorite television program because a car with a burned-out muffler is cruising along your street.

Traffic noise makes people cranky, ruins their home enjoyment and can seriously damage their property values.

Mechanical engineer Gene Bolstad, who specializes in noise problems, says: "From a community response point of view, traffic noise is far and away the big, number one thing." Railway and aircraft noise are close seconds, say experts.

There are three lines of attack to tone down transportation noise:

- change or shield the route;
- shield people from the noise;
- change equipment design to make vehicles more quiet.

Berms, barriers and combinations of the two have been the most popular methods so far to shield the route.

Barriers may range from a few hundred metres to several kilometres long, such as the four-kilometre steel barrier along Highway 401 in Ontario.

The height of the barrier is, in part, determined by the height of the noise. But the noise may be at ground level where tires hit the pavement or at the top of a diesel exhaust stack, about three metres high.

Because of the way sound moves, the barrier should be as close to the roadway as possible, says a 1980 consultant's report prepared for the city of Edmonton. If that's not possible, it should be close to the homes. The barrier is least effective in the middle.

The cost of putting up the barrier depends on the individual circumstances but materials usually make up about 70 per cent of the cost. Because barriers may also interfere with drainage, special flumes or culverts may be required.

A 4.5-metre barrier of wood costs $45 a square metre; steel costs $145; concrete costs $80 and a wood-concrete combination costs $65.

Barriers have some disadvantages. They attract graffiti artists, can cast long shadows in summer and cause snowdrifts in winter.

But they may also break winter winds, cutting down heating requirements.

Berms offer another solution to noise. A berm is a mound of earth that extends along a noise source. It's usually a few metres tall, depending on whether it's used alone or with a fence.

Because the slope grade is usually about three to one, much land is required to build a berm. The maximum height is usually about five metres, although some have gone as high as 17 metres.

Berms can be built of waste grading material and be landscaped into terraced gardens and play areas, says J. Manuel, supervisor of the noise pollution control section of the Ontario environment ministry.

They also deflect the sound upwards instead of reflecting it from one side of the source to the other, and provide an absorptive surface.

But they have their disadvantages too. Many people like to ride trail bikes on them, which defeats the purpose of cutting out noise and can also be dangerous. One child was killed last year in Edmonton riding a trail bike on a berm, says Malcolm Palmer, of the city's transportation systems design department.

If people walk along a berm with no fence, they can see in the windows of the homes below, much to the concern of the residents. The berm can also be expensive because it takes up so much land.

The berm-fence combination solves some of the problems of both berm and barrier. It takes up less land because the base doesn't have to be as wide. The fence not only gives additional noise protection but affords residents more privacy.

For instance, one berm-fence combination along a major Edmonton road is made of a 1.5-metre berm and a 3.5-metre steel wall.

Developers started using berm-fence combinations as an alternative to Edmonton city council's 61-metre setback on all new developments near a truck route, says Palmer.

If this setback was enforced around the perimeter of a 2.5-kilometre subdivision, it would render 15 per cent of the land useless, pushing the price of each lot up $5,000.

So council began exempting developers who provided a suitable barrier or berm. Originally, developers used only a berm and placed it outside the lot line. Now, however, the property line is at the peak of the berm and a fence is usually used as well.

This saves almost 18 hectares of land over a 2.5-square-kilometre subdivision, a saving of $6.5 million. However, many homes now have only three to four metres between their back doors and the toe of the berm. On a regular lot, they might have as much as 10 to 12 metres.

The Mayfield Road barrier in Edmonton is one example of the berm-fence combination. It cost $1,098,915 and reduced noise levels from 71 to 60 dbA Ldn (decibel levels weighted for human hearing and with day/night noise levels taken into account).

But berms and barriers aren't always possible. In one noise-afflicted Edmonton neighborhood, there is almost no land between the road and the back lotlines. A five-metre wall was suggested to residents but they rejected it because they would have been in constant shade. "They really got hostile about the whole thing and said: 'To heck with you. Take away the vehicles,' " said Bolstad.

He suggested other ways of shielding the route: a tunnel could be put around the traffic, as the Japanese have done in some cities. The tunnel sits on the surface, completely enclosing the traffic except for slots for ventilation. Residents are shielded from the traffic and snow and ice would not accumulate in winter. It would be quite expensive, but Bolstad says it might still be feasible in cases where little else can be done.

Every noise problem has a solution, he says. It's just a question of how expensive it is. "They usually get impossible when you start talking about the dollars associated with them and that's usually when it gets down to a bitter fight," says Bolstad.

Architectural modifications can also shield people from noise.

Before dwellings are built, architects should consider which parts of the home will be exposed to noise and ensure that bedrooms and recreation rooms are moved away from that area. Noise is less important in corridors, kitchens and bathrooms so they can be placed nearer the noise, says Manuel.

Tim Beier

Balconies and terraces should also be placed away from noise, perhaps just on one side of a building. Blank walls can be used to face the noise source, and windows placed elsewhere.

The quality of construction in caulking and joining is also extremely important if the home is to be insulated against sound.

For existing buildings with noise problems, retrofitting may be required.

In our climate, the exterior wall is usually adequate. More insulation won't help, says Bolstad. But while glass fibre is a pretty good sound absorber, urethane foams are too light and stiff to absorb sound energy. Glass fibre actually moves when sound waves hit it, converting the energy to motion and heat.

Windows are usually culprits. They may be sealed, made smaller or the glass thickness increased, using double or triple panes of glass. An additional exterior sash may do the trick.

But people must be prepared to live with closed windows if they want quiet. For that, they'll need mechanical ventilation. The cost of retrofitting can range from a few hundred dollars to several thousands, says Bolstad.

Another means of isolating people from noise is through land use planning.

The buildings, facilities and other areas that need the least quiet are placed nearest the noise.

In an area of apartments, parking can be put near a busy road, rail track or rail yard. Commercial or light industrial areas which don't need quiet can be zoned near major roadways. A visual shield can then be put between the commercial district and the residents.

Buildings themselves can act as barriers. For instance, townhouses could be arranged to form a courtyard around a small, grassy area, perhaps with a common swimming pool.

Tim Beier

These "barrier blocks" don't need to be excessively high. To be fully effective, though, they must be continuous and as close to either the source of the noise or the sensitive area as possible, says Manuel.

If a barrier building is used to protect a site, planners must make sure the building itself isn't bombarded with noise. Architectural techniques may be used to overcome this.

If traffic can't be rerouted away from a residential area, sometimes the residents can be moved instead.

"They did this very successfully along the north side of 149th Street between Stony Plain Road and 107th Avenue (in Edmonton)," said Bolstad. "They created a little park with landscaping and berming."

In other cases, residents have successfully petitioned to have trucks removed from their street.

The noise level drops about eight decibels once the trucks are gone but they still have to go somewhere, says Palmer.

Trucks are forced to take a longer route, increasing the noise levels along the detour and the number of people exposed. For example, the removal of a 1.6-kilometre stretch in Edmonton forces a 5.4-kilometre detour for nearly 3,500 trucks daily, at an operating cost increase of about $2 million annually, says a brief to the Environment Council of Alberta's public hearings on noise presented by Edmonton city officials.

The total cost of truck detours is not known.

It was suggested that all restrictions be dropped, thereby spreading truck traffic uniformly throughout the city. But this would reduce the noise level by only three decibels and the total costs of reducing levels still further would be horrendous.

In 1974, the city developed a truck route loop with a system of routes into major industrial demand zones. But residents again

Lauren Dale

Tim Belec

objected to trucks on their streets, says the city brief.

An outer ring road was suggested as a solution to truck noise, but over 80 per cent of highway truck traffic either begins, ends or must stop over in Edmonton.

Planners could simply limit the number of trucks travelling in the city but Bolstad says: "I think you know how popular that would be."

Edmonton alderman Bettie Hewes says traffic noise is approached in a number of ways. Trucks are designated to specific routes and may be restricted to travelling at certain hours, between 7 a.m. and 8 p.m., for instance.

New neighborhoods have moved away from the grid plan for streets. Instead, they are arranged so traffic shortcuts through residential areas are inconvenient. This cuts down on noise and is safer.

The third alternative for quelling noise is toning down the noisemakers themselves.

It has been found that heavy trucks make the greatest contributions to traffic noise. "But although trucks cause a lot of the grief, they are also essential to our economy," says Alistair Crerar, chief executive officer of the Environment Council of Alberta.

Transport Canada standards prohibit truck noise louder than 83 dBA as the vehicle passes by and 90 dBA on the inside.

When a truck rolls by, it may just sound like a generalized roar, but it's really the interaction of many noisy parts.

Truck manufacturers are working to reduce noise levels but results are coming very slowly, says Bolstad. Although some changes would make the vehicles less energy-efficient, the compromise isn't nearly as serious as some would have us believe.

"There's a lot of simple inertia. The trucking firms refuse to believe that something they've lived with four or five years can be improved on."

It would cost about $1,000 per unit, or $65 million to bring every truck in Western Canada to well within acceptable noise limits, he says. But he points out that $65 million doesn't go far in building berms, reserving land and retrofitting houses.

"We're now coming down to the crunch. It starts to come home to individuals as they open their windows and listen to the roar that, by golly, it's here. It's not in Los Angeles, it's in good old Goldbar, in Edmonton. Then they start to get excited and start to talk to their legislators."

At speeds less than 56 kilometres per hour (35 mph) the engine, intake and exhaust and cooling fan are the noisiest parts of a truck. Transmission, tire and air turbulence noise increases after this speed.

A massive engine block with a proper enclosure of heavy steel, lined with acoustical foam, totally enclosing the engine, would be most effective but it would also reduce fuel efficiency and make repairs very cumbersome, says Bolstad.

The U.S. department of transport's Quiet Truck Program found a lightweight enclosure with numerous gaps and special mounts would cost about $1,161 and reduce the noise by about three dBA. The most effective engine treatment cost $928 and could reduce noise by 16 dBA.

A turbocharger uses waste exhaust gas to drive a compressor turbine. This not only conserves fuel, it smoothes the exhaust pulses of the engine, thus reducing noise. A clutched fan, which is disengaged by a thermostat when it is not needed, not only cuts down on the overall horsepower used, but cuts out unnecessary fan noise. The cost of installing the fan clutch has been estimated at $350.

Dual exhaust systems can also reduce exhaust noise and enhance fuel economy.

On the highway tire noise is the most troublesome problem. The cheaper the tire, the noisier it tends to be, says Gary Faulkner, professor of mechanical engineering at the University of Alberta. The noise is caused by the compression and release of air in the tire treads. It can be reduced somewhat by randomizing and spacing the grooves in the tire.

John Lackie, assistant chief engineer for Canadian Kenworth Co., told the recent public hearings on noise that truck maintenance is very important in preventing noise. "Even a pinhole leak in the exhaust system can mean a .5- to one-dBA increase in noise."

The wrong muffler or fan blades can also create additional noise and a broken clutch fan thermostat can increase sound as much as four dBA.

Quite a bit can be done to silence trains as well. Very few locomotives now operate with mufflers although this would create a significant noise reduction, says an ECA background paper. Vibration damping techniques and absorptive materials could be used around engine enclosures.

As well, the number of joints in the rail itself affects noise levels. Noise has been reduced somewhat by welding five or more regular rails together, then joining these longer rails in the conventional manner.

Considerably less can be done about aircraft noise. Engineers have developed much quieter jets but it will still be several years before the older, noisier models are retired.

The federal government restricts development around airports for noise and safety reasons.

At the Edmonton municipal airport, there is supposed to be a curfew of 11 p.m. and flights are not supposed to leave until 7 a.m. "But it's a fact of life that schedules are not kept," says Crerar.

Noise problems don't always get the attention they deserve. Until they do, cost-efficient solutions won't be forthcoming.

Jenny Hughes is a journalist in Edmonton.

Louise Horstman

Effects On Wildlife

Noise stress might sometimes be the last straw.

Filing slowly across the barren mountain slope, the group of Dall sheep descended toward the Canning River valley.

Near their destination, the extensive mineral lick at the top of the valley, the lead ewe halted. A loud noise from the vicinity of the lick shattered the arctic morning stillness. The group hung back nervously; the sound persisted. The ewes lay down on the trail and waited.

Some 250 kilometres to the east, between the northernmost slopes of the Yukon's British Mountains and the Beaufort Sea, a large flock of snow geese approached the marshy coastal plain. Used for centuries by countless numbers of waterfowl, this isolated area served as a staging ground where birds could rest and feed before their southward migration. Spotting decoys in the area, the geese spiralled downward. But didn't land. A strange noise emanated from the vicinity of the decoys. The flock wheeled sharply and departed.

Thus began two of the first and only experiments to study the effects of noise, apart from any visual stimulus, on wildlife.

The year was 1972. The Canadian Arctic Gas Study Ltd. and Alaskan Arctic Gas Study Co., groups formed to study the feasibility of a gas pipeline from Prudhoe Bay, Alaska through the Yukon to the Mackenzie River and thence south into Alberta, were faced with one of many environmental questions: how wildlife in the remote parts of the route would react to the noisy 20- and 30,000-hp gas compressor stations that would be needed every 80 kilometres along the pipeline. Would animals avoid these areas permanently or temporarily or would they become accustomed to the noise?

By anyone's standard, a gas compressor station of that size is extremely noisy. Its gas-driven turbine engine sounds like a jet preparing for take-off. At five metres, the sound level is about 110 dB, and at 100 metres about 90 dB. Where the noises of civilization have not yet penetrated, this would represent no slight auditory disturbance.

Of course, animals could simply avoid the noisy sites if they chose — or could they? Winter ranges, calving grounds, mineral licks, staging areas and other locations can be crucial to the survival of a wild population; equally good alternative sites often do not exist.

To answer their questions, a special noise-making machine was designed. This electronic device, referred to as a "gas compressor simulator," was capable of imitating all the sound components of a gas compressor, either singly or in combination. Resembling a rock sampler on the moon, it was set up on the barren mineral lick.

Hundreds of observation-hours later, consulting biologist Patricia Reynolds summarized the results. From what she and her assistants had been able to observe, the sheep were not disturbed by any of the simulated noises. Apprehensive at first, the sheep had proceeded to the lick within an hour. The same average number had visited the lick whether the simulator was running or shut off, and had spent the same amount of time at the lick in either case.

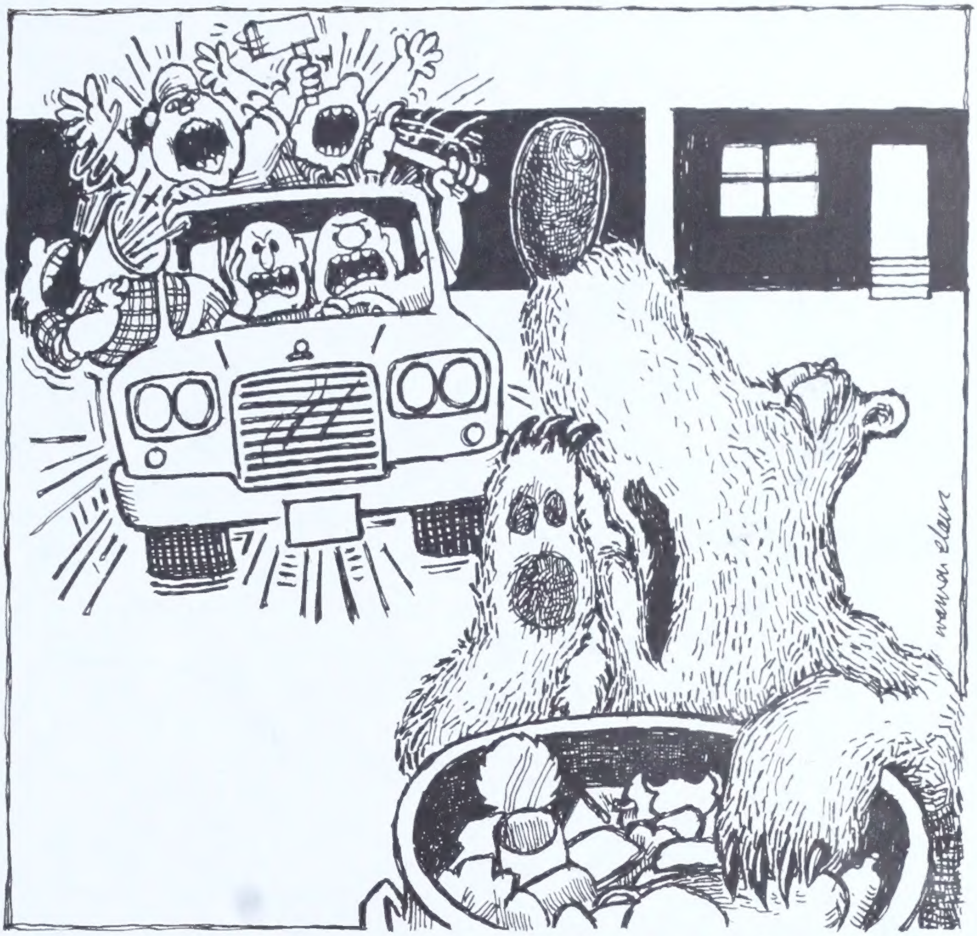
Some people said the outcome was predictable and the study needn't have been done. After all, cows often graze near compressor stations in Alberta and moose are seen around them too. Dr. Arthur Bergerud, a caribou specialist at the University of Victoria, reported that one herd of this normally "shy" species wintered within 1.6 kilometres of the CN railroad and within 3.2 kilometres of the TransCanada Highway and showed no fear of the noise from trains, vehicles, or chain saws. Everyone can cite examples of wild animals ignoring loud noises.

And yet, in the goose-simulator study, significantly fewer flocks landed to feed and significantly more flocks changed their direction of flight when the simulator was operating than when it was silent. Some flocks feeding as far as 4.8 kilometres away departed when the simulator was turned on. The consulting biologists conducting the test concluded that "if optimum goose areas cannot be avoided when building the (compressor) stations, then either the stations should be shut down during the staging period, or an efficient muffler system should be incorporated."

That's birds, some might argue: flighty by nature. But look at these findings: pigs exposed to 130 dB of 300-600 Hz noise for 15-second intervals show an increase in heart rate after the fourth repetition; taped aircraft noises played to hens at 120 dB for eight out of every 20 minutes cause them to stop incubating eggs; while (randomly generated) noise played at 100 dB to domestic lambs causes a significant rise in heart and breathing rates.

These and other experiments were conducted in various laboratories by many researchers in attempts to understand the

Moose: for wildlife the frontiers of quiet are shrinking.



physiological effects of noise. Some of the experiments were more remarkable for their choice of treatment than for their results; for example, cows were subjected to the sound of exploding paper bags every few seconds during milking (with predictable results on milk production).

The gist of the findings soon became clear: noise can definitely exert stress on animals. Its effects may not be visible in the animal's behavior, but are measurable in endocrine output and resulting physiological and sometimes even reproductive changes.

For wildlife individuals or populations, an additional stress coming at a time of high naturally-occurring stresses such as a severe winter or fly season, can be the last straw. Also, there may be times when noise is more of a stress than at other times, for example in spring, when females with young are often more sensitive to disturbance.

Might the sheep have been undergoing some stress-induced changes even though they remained at the lick? The experiment, as Reynolds points out, was not designed to answer this. However, we can venture a guess, based on physiological measurements on domestic animals in laboratory situations. These animals do appear to become accustomed to frequent or constant sound, if not too excessive and in the absence of any adversive associations. Domestic lambs previously acclimatized to white noise, for example, have lower heart rates during 100 dB white noise treatments than do unacclimatized lambs exposed to lower sound intensities.

The differences between repelling a bear in Churchill, Manitoba and at an oil rig camp in northern Alberta is another case in point. Many residents of Churchill carry small freon-powered boat horns in their vehicles to ward off polar bears. These horns emit a loud, piercing noise which, according to a study by Gary Miller of the University of Montana, is effective about 80 per cent of the time in deterring the bears.

Such a deterrent seems almost ludicrous to Alberta Fish and Wildlife officers who handle industrial bear complaints. Ron Hanson, problem wildlife specialist with the division, describes what happens when a vehicle loudly blowing its horn drives up to a bear in an oil rig camp: nothing. The bear has become totally acclimatized to loud noise.

If familiarity breeds contempt, what about the occasional loud noise? European animal scientists in the late 1960s turned their attention to the effects of sonic booms on farm animals. To investigate this, they employed portable sonic boom simulators. Pigs, horses, cattle, sheep, wild turkeys and deer were given the boom treatment; only mild reactions at the first boom and little or no response to subsequent booms were noted. Ravens, however, showed strange congregating behavior following a real sonic boom. And it was found that extreme sonic booms can break birds' eggs.

Either the animals tested had already heard enough booms or related noises to become acclimatized, or something about the sound quality simply didn't disturb them. As Bergerud points out, the strongest response-evoking sounds are those which have traditionally been important to the animal in its natural environment. These biologically meaningful sounds would include those made by the species' predators, other natural danger signals (such as ice cracking), and intra-specific communication sounds for a variety of purposes — mate-calling, territorial defence, and so on.

Yet another sound simulator demonstrates the evocative potential of natural communication sounds. Donald Wooldridge and Peter Belton of Simon Fraser University's pestology centre electronically reproduced the growls and hisses of two male polar bears confronting each other over one piece of meat. Played at 100 dB to free-ranging black, brown and polar bears, these sounds usually resulted in rapid retreat of the bears.

The idea of biologically significant sounds may also explain why the low hum of transmission lines is reportedly disturbing to the semi-domesticated reindeer herds in Norway. According to Dr. R. Klein, herders have difficulty driving the herds under such lines. Perhaps the sound is reminiscent of the swarms of flies which plague the species in summer.

Given enough time, animals are capable of learning the significance, or lack thereof, of infrequent man-made noises. Propane-driven scare cannons, used to keep elk and deer away from crops and haystacks, lose their effectiveness after a while. The learning is probably fastest when such noise is associated with adverse consequences, such as the sound of vehicles and hunting. Will fish, within whose hearing range falls the underwater sound of commercial fishing vessels, learn to avoid these sounds?

Will polar bears get wise to boat horns? Time will tell.

Louise Horstman is an Edmonton-based wildlife biologist and freelance writer.

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Environment Update

Acoustics Week Planned

Acoustics Week, sponsored by the Canadian Acoustical Association, will be held in Edmonton during October, 1981.

A highlight of the week will be a three-day seminar called "Controlling Transportation Noise," which will feature North American experts on the control of noise from road and rail sources.

Course planners note that basic jargon and current methodology are covered, so participants need no background in acoustics. The course is recommended for planners, architects and policy-makers who face the problem of controlling transportation noise and assessing its impact on the community.

Other activities during Acoustics Week will include the Canadian Acoustical Association's annual symposium, a machinery noise control seminar and the annual meeting of the Canadian Standards Association acoustics and noise control committee.

Those interested should contact:
C.A.A. — 1981 Convention Committee,
Box 5768, Station L,
Edmonton, Alberta, T6C 4G2.

Aquatic Research Reviewed

The second biennial Plains Aquatic Research Conference will be held at the University of Calgary on August 25 and 26.

The conference is being organized by the Kananaskis Centre for Environmental Research and Alberta Environment, in cooperation with the Canadian Plains Research Centre.

More than 30 papers will be given on such topics as planning and engineering, pollution monitoring and research, and limnology and aquatic ecology of lakes and streams. The final afternoon will feature a symposium on "Energy Development on the Plains: Water Resource Conflicts."

For information and registration details, contact the conference chairman, Bruce L. Baker, Kananaskis Centre, University of Calgary, Calgary T2N 1N4 (phone 284-6124).

Environment Week Coming

The week from October 11 to 17 has been designated Environment Week across Canada. This year's Environment Week theme is "Join the environment team."

Among planned activities, a Prairie Action Conference, funded by Environment Canada, will be held at Camp Raynor near Saskatoon. It will bring together environmental groups from the three prairie provinces to discuss issues of common interest.

Study Results Out

Overall results of two 1981 winter air pollution studies, released by Alberta Environment in late July, support 1980 spring and summer study results which showed no evidence for relating human health problems in the Pincher Creek-Waterton area to monitored air pollutants.

The special winter air quality survey by Alberta Environment and study of selenium levels by the University of Calgary's Kananaskis Centre for Environmental Research, were conducted after area residents and a medical specialist expressed concern that air pollution levels might be more severe in winter than in spring or summer.

No differences were found, between the spring and winter monitoring periods, in the concentrations of eight different pollutants. Study results also showed selenium levels to be lower in winter than in summer.

Alberta Environment will soon be finalizing plans for further studies in the area.

Conferences At Banff

Two conferences of environmental interest are shortly to be held at the Banff Centre.

The first, scheduled for Sept. 10-12 and called "Transition to management," focusses on Canada's forests.

It will be the first of a series of national conferences on Canada's resources. Its purpose is to provide an agenda for action to aid in the successful transition from the era of natural forests to that of managed forests.

The second conference, aimed at senior and middle management, is an environmental assessment and project planning workshop, scheduled for Sept. 19-26.

The workshop will look at ways of streamlining the project approval process, social and environmental impact assessment methods, the project planning assessment process, public consultation and information, and review agencies and the public hearing process.

If you have a short news item of province-wide interest you'd like to contribute to Environment Update, please send it to the editor at the address on the Contents page. The editor reserves the right to select and edit the items.